RURAL FACTOR MARKETS IN PAKISTAN

by

Ijaz Nabi

a Ph.D. thesis presented to
University of Warwick, Coventry, CV4 7AL, England

Department of Economics
January 1981

RURAL FACTOR MARKETS IN PAKISTAN

A summary

Four important and inter-related issues in the economics of agriculture in developing countries are production efficiency, tenancy, technological innovation and rural-urban migration. These issues are examined in this study by analysing the working of rural factor markets using empirical evidence on selected farmers in four villages and an important sub-division in Pakistan's Punjab province.

The pattern of land holding in Pakistan suggests that land is very unequally distributed. This observation is the basis for may proposals of land reform. It has been argued that inequality in land distribution is undesirable *per se* as well as because it leads to inefficiency in agricultural production. Empirical evidence from the villages suggests that an inverse relationship exists between farm size and productivity thus lending support to the second part of the argument. Explanations in terms of the working of rural land and labour markets are offered for the existence of the relationship.

Tenancy is important in Pakistan. Its existence is explained in terms of adjustments in factor endowments by landowners and landless cultivators given that markets for labour and draught power operate imperfectly. Different tenurial contracts imply different sets of incentives that influence decisions regarding resource allocation on the farm. The empirical evidence suggests that adjustments are made - such as devising cost-sharing, input stipulation and supervision arrangements - to ensure that different tenurial contracts are equally efficient.

It is argued that despite the apparent difficulties of access to 'green revolution' technology inputs due to imperfections in their distribution and scarcity of rural credit, small farms use inputs such as high yield variety seeds and chemical fertilizers no less intensively compared to the large farmers. The evidence suggests that new markets for factor services and intricate but more accessible networks of fertilizer and seed distribution may have developed to facilitate the use by small farmers.

The relationship between migration and rural credit markets is examined. It is argued that migration may improve the credit ratings of households and thus may facilitate borrowing in the rural credit market. Detailed comments are also made on the role of other rural-end variables such as non-farm income, mechanization, output *per capita* , education and available land *per capita* in influencing the decision to migrate.

The underlying theme of the study is the analysis of operations in rural factor markets. We analyse, carefully, interactions in these markets and then examine some important aspects of policies in the light of our analysis of the four issues.

ERRATA

Due to a typing error, Page No. 67 is missing. The total number of pages is therefore 357.

CONTENTS

ACKNOWLEDGEMENTS

I have accumulated substantial debts in the course of writing this thesis. The guidance and advice of my supervisor, Professor Nick Stern, has been invaluable. His enthusiasm for the issues analysed here and general encouragement helped me through many periods of doubt and difficulty. I am very grateful to him for the time that he devoted to our discussions and correspondence and for enabling me to appreciate the value of being well-organized.

This study has been made possible by the generous leave granted to me by Quaid-e-Azam University, Islamabad, under its central overseas training programme. I hope that in analysing the issues presented in this thesis, that leave will have been well-utilized. My colleagues at the Department of Economics, Quaid-e-Azam University, were very kind in allowing me access to data collected by them for a study of rural poverty in Pakistan. In particular, conversations with Ali Ercelawn helped to translate series of numbers into the realities of rural activities. His warm hospitality improved the quality of life remarkably.

I take this opportunity also to express my gratitude to the Overseas Development Administration, U.K., for financing the field study in Khanewal under Research Scheme R3487. In Khanewal, farmers patiently sat through long interviews and answered my questions with grace and inexhaustible good humour. To them, I dedicate the contents of this thesis.

Many others have contributed to this thesis by way of discussions and helpful suggestions. Especially, I would like to thank Shiv Nath, Dennis Leech and Peter Burridge. I am particularly indebted to Keith Halstead at the Computer Centre, who kept his door open despite his many commitments.

I owe special thanks to Gail Trapmore for helping me to distinguish one day spent at computing from another and for the arduous task of proof reading.

Finally, and importantly, Liz Thompson has been very patient and kind while transforming the illegible manuscript into the typed version.

LIST OF TABLES

Page No.

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Page No.

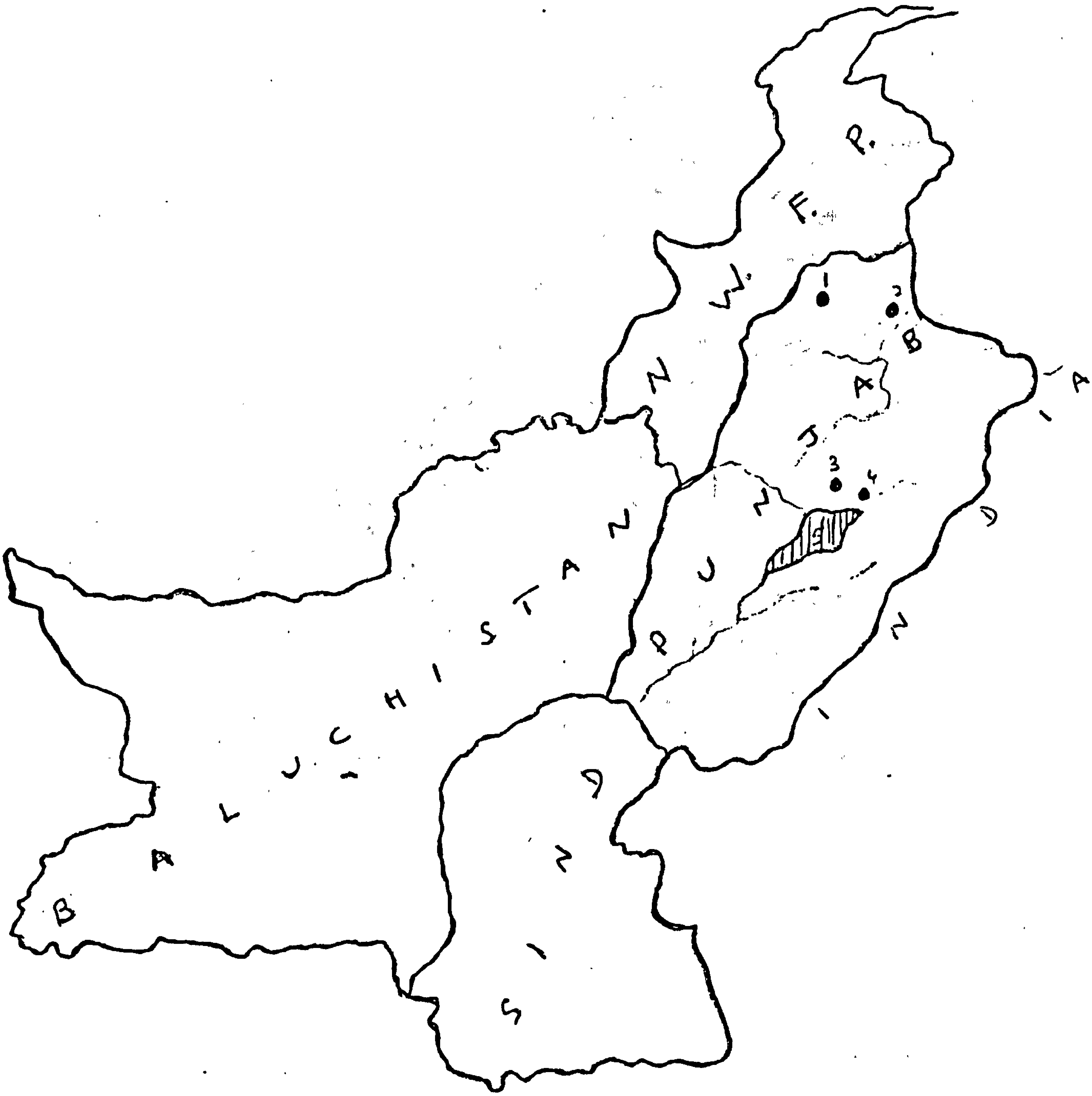
Page No.

Chapter 6

Chapter 7

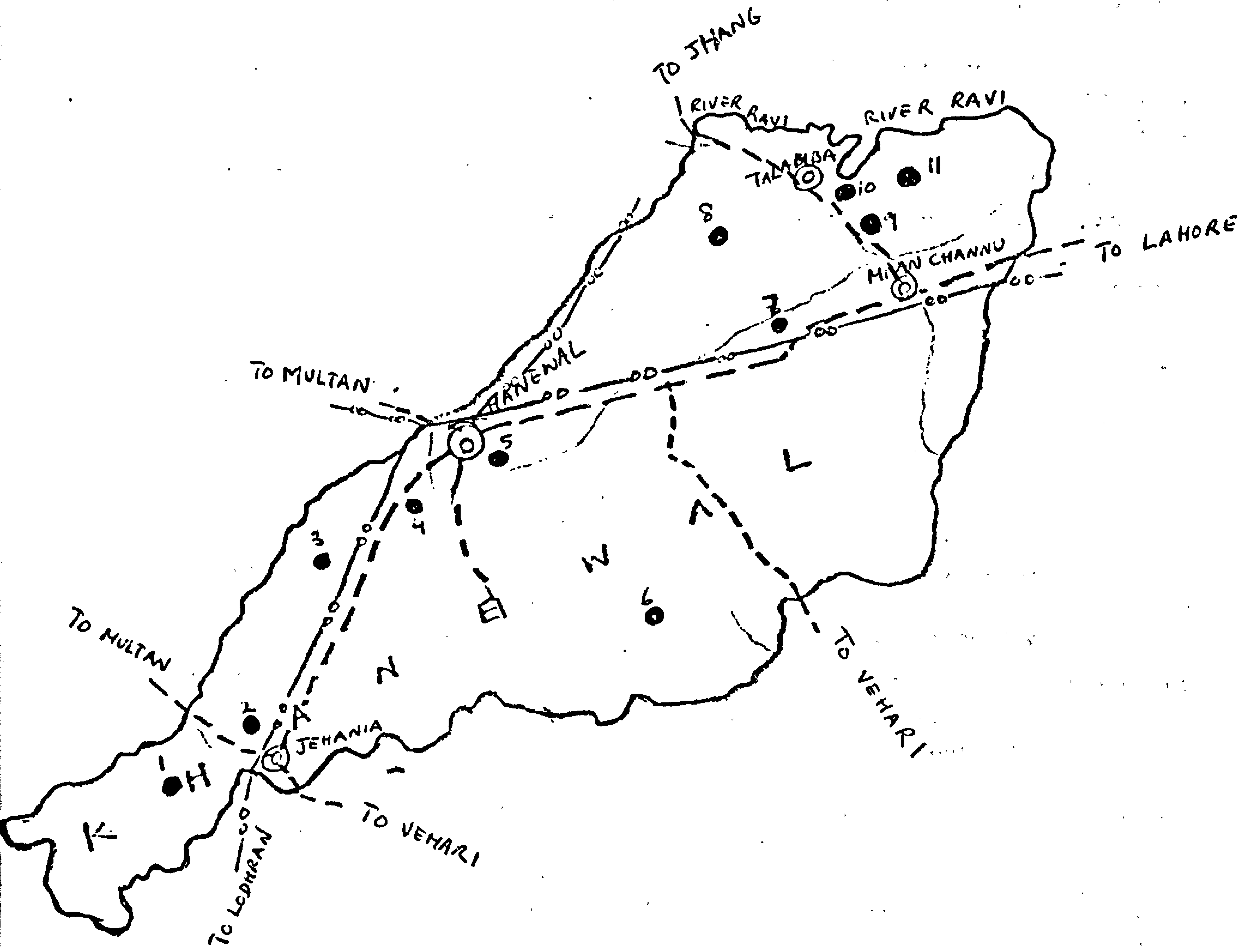
Page No.

Figure (i) Map of Pakistan showing the four villages and Khanewal Tehsil



1. Khunda
2. Jatli
3. Mehdiabad
4. Chak 305
5. Khanewal Sub-division

Figure (ii) Map of Khanewal Sub-division showing the sampled villages



Villages

1. 114/10-R
2. 113/10-R
3. 157/10-R
4. 168/10-R
5. 88/10-R
6. 66/15-L
7. 133/15-L
8. 17/8-R
9. Pukka Haji Majid
10. Basti Santpal
11. Kot Barkat Ali

KEY

Symbol	Meaning
◎	Towns
—oo—	Railway
- - - -	Road
——	Canal
●	Villages

GLOSSARY

arhtia	:	a middleman engaged in commodity exchange in market towns.
baithak	:	the front room in a farmer's house used for receiving visitors.
barani	:	areas dependent on rainfall for cultivation. In particular, it implies the absence of canal irrigation.
beopari	:	a middleman engaged in commodity exchange in the village.
birathori	:	literally, brotherhood. A broad caste category.
dhani	:	a popular breed of sturdy bullocks used for ploughing; indigenous to the submontain division of Rawalpindi.
kammi	:	a broad caste category which includes non-cultivating households engaged in seasonal farm labour and other menial village tasks.
kharif	:	the crop season lasting from June to October.
lambardar	:	the village head-man, usually someone who owns land and is well-respected in the village.
malik	:	a big landowner.
munshi	:	a bailiff.
patwari	:	a government servant who keeps village records for land revenue assessment.
rabi	:	the crop season lasting from November to May.
rajwah	:	a distributary carrying water from a canal to the village.
tehsil	:	an administrative unit within a district. Now commonly known as a sub-division. Three to four sub-divisions comprise a district.
thana	:	a police station. Also an administrative unit. There are three to four thanas in a tehsil.
vaar	:	literally means a turn. Usually used in connection with the distribution of canal water in the villages. In well irrigated villages each plot of land gets one 'vaar' of irrigation (measured in terms of acre feet of water) every seven days.

CHAPTER 1

INTRODUCTION

Section 1.1 The issues

This study is concerned with four inter-related issues in the economics of agriculture in developing countries. These are production efficiency, tenancy, technological innovation and rural-urban migration. We shall not attempt a comprehensive analysis of each of these issues separately. Instead, we shall concentrate on certain aspects that are important in highlighting their inter-relationships. The analysis will be carried out by using empirical evidence from Pakistan.

The pattern of land-holding in Pakistan suggests that land is very unevenly distributed. Most of the land is owned by a few large farmers while the majority of the farmers have small holdings that comprise a very small proportion of the total available land. This observation is the basis of many proposals for land reform. It is argued that inequality in land distribution is undesirable *per se* as well as because it leads to inefficiency in agricultural production. In this study we shall attend to the second part of the argument and examine the relationship between the size of farm and production efficiency. We shall investigate the hypothesis that small farms have better access to inputs such as family labour and soil fertility compared to large farms and this makes them relatively more productive.

Tenancy is important in Pakistan. The most frequently observed categories of tenancies are share-cropping and fixed-rent tenancies.

Different land tenure arrangement may imply different sets of incentives that influence decisions regarding resource allocation on the farm. For example, share-croppers are required to share crop output with landowners. This may result in less intensive use of inputs. But tenancy contracts may be adjusted to take into account such disincentives. Costs of inputs may be shared and strict supervision may be exercised to ensure efficient resource allocation. After arguing that tenancy is not necessarily a 'remnant of an inefficient historical past' (as implied by the literature on tenancy reform , see,for example,Bhaduri (1973) and Bell (1977) we shall discuss the important determinants of tenancy. It will be argued that in a world where factor markets operate perfectly there would be no need for tenancies. In the real world, however, market imperfections are a common feature so that tenancies may result from an adjustment in factor endowments by landowners (who have excess land given labour) and tenants (who have an excess of labour given land).

The importance of 'green revolution' technology is apparent from the voluminous debate that has been generated regarding the pattern of its spread and the impact on productivity, income distribution and rural employment. It has been argued that due to imperfections in the rural credit markets and inefficiences of government distribution systems small farmers have restricted access to the new inputs so that the relationship between farm size and productivity may change. An important issue that needs to be examined in this regard concerns the nature of changes in the rural factor markets brought about by the 'green revolution' technology. There exists some evidence to suggest that new markets for factor services (such as purchasing tube-well water for irrigation and ploughing with hired tractors) and an intricate but more accessible network of fertilizer and seed distribution may have developed to facilitate the use of new inputs by small farmers. This evidence requires a careful examination.

In the standard approach to studying rural-urban migration, it is argued that individuals migrate because of a difference in the expected incomes between urban and rural areas. In this approach concern with migration arises in part on account of its impact on urban labour markets and public services as seen in the growth of, respectively, urban unemployment and shanty towns. This partial view of migration ignores the importance of the flow of remittances to the rural areas. A comprehensive approach to rural-urban migration requires the analysis of decisions concerning welfare maximization by joint households in the rural areas. Liquidity requirements of rural households may be high and may not always be met in the imperfectly functioning rural credit markets. Therefore, remittances from household members employed in the urban areas may be an important source of finance. When technological change occurs liquidity requirements of farming households may acquire greater significance. We shall explore the relationship between migration and rural credit markets and comment in detail on other rural-end variables influencing migration.

Our summary of the four issues indicates that the underlying theme of this study is an analysis of operations in rural factor markets. The issues are examples of production arrangements that result from decisions taken by households regarding resource allocation in imperfectly operating rural factor markets. A careful analysis of the interactions in these markets will enable us to examine the wider implications of policies aimed specifically at the four issues.

Section 1.2 Data

A data set that has been used extensively for discussion of empirical issues surrounding the agricultural sector in Pakistan is the Pakistan Census of Agriculture compiled by the Ministry of Food and Agriculture, Government of Pakistan. Two censuses have been conducted so far. The first covers the period up to 1960 and the second brings the data base up to 1972. While the data collected in the two censuses are very comprehensive there are problems of consistency arising from changes in methodology (see S.M. Naseem 1979). The main problem with this data base is that it does not report data on crop output. One way to overcome this is to supplement the census data with data on output from other publications of the Ministry of Agriculture (such as the annual provincial agricultural statistics). But this is likely to worsen the problem of consistency since selection of the sample for these publications is done independently of the method used in the census. For our purposes, however, a serious problem arises with the census data on account of the level of aggregation. The two censuses report results for specific size-classes at the district level[1/]. The district is far too aggregate a unit of observation for a discussion of issues that we have outlined in Section 1. However, we shall present general economy-wide evidence during our discussions throughout the thesis as a background to the more detailed analysis of the empirical issues that concern us. We shall refer to the census data in these discussions.

The empirical issues that interest us are best investigated with the type of data base available in the Farm Management Surveys in India. These

---

1/. The 1972 census reports data on a subset of variables at the sub-divisional level (a smaller administrative unit) also but the number of variables declines sharply and the level of aggregation still remains.

surveys collect data at farm level from villages chosen in five representative states in India. The sample was chosen by a multistage stratified random sampling procedure. Such data were not available in Pakistan.

Alternatively, farm level data may be obtained from village studies. These data were available in the village studies conducted by a research team at Quaid-e-Azam University, Islamabad. The team consisted of research investigators who were members of the Department of Economics at Quaid-e-Azam

The village studies were sponsored by the Economics and Social Commission for Asia and the Pacific, E.S.C.A.P.(U.N.), Bangkok, as part of a project on social participation in rural development. The field work on the studies was started in November 1976 and lasted for 15 months. The objective of the study was

> "a close understanding of the condition of the rural poor in different environmental settings ..... to be able to identify the direction in which change was occurring and affecting the rural poor in different environmental settings." (E.S.C.A.P. Mimeo, p.2.)

Thus the research team was given a wide brief.

The sample of villages chosen by the research team was by no means randomly selected but an attempt was made to get a representative picture of the poverty profile in the country. In its preamble the research team writes

> "In view of the vastness of the country, we considered it necessary to capture the ecological, regional and institutional variations in the country which generate the principle types of poverty situations in the country.....We did want, however, to get a set of villages in the Indus basin which would broadly reflect the regional, ecological and institutional differences.....We decided to choose villages from the three provinces of Punjab, NWFP and Sind in a manner that would bring out the effect of the major factors on the poverty situation in each province. We decided to put greater emphasis on Punjab, not only in view of its importance and weight in the economy, but also because of the great variations within Punjab as well as because it was easier for our core team members to supervise the research work

within Punjab. Initially it was decided to choose three villages each in the irrigated and unirrigated areas. After taking care of the regional and ecological factors, we decided that the villages chosen should reflect the variations in tenurial arrangements as well. It was with a view to this that of the three villages in the unirrigated areas in the Punjab, one, viz Khunda, was chosen because most of the land in it belonged to a few big landlords and the majority of farmers were tenants. The other two villages in unirrigated Punjab, viz Mandhar and Jatli, were small farmer villages where owner-farmers dominated. These two were close together but had important differences in regard to urbanization, education and use of new agricultural inputs. We thought that their inclusion would bring out the causes of the differences in the extent of poverty in a relatively similar ecological and tenurial situation.

The two villages in irrigated Punjab were chosen on similar considerations. One of the villages, Mehdiabad, is again a big farmer village while the other, Chak 305, is inhabited by small owner-farmers.

Similar ecological and institutional considerations dictated the choice of the two villages Rukrani and Manojamali in Sindh and Nari and Hasan Dara in N.W.F.P. Baluchistan and Northern Hill areas were excluded altogether to avoid extreme cases, as well as to keep the logistical problems at a manageable level." (E.S.C.A.P. Mimeo, pp.3,4)

Thus,

"the basic strategy of the selection of villages was to isolate the difference in poverty situation due to different factors. Frequently consideration was given to specific features of the villages such as accessibility, incidence of migration, landlessness, peasant solidarity etc. - issues on which it was hoped to focus. Thus our methodology of choosing the villages was aimed at making the sample as representative as possible. Within the given limitations, by choosing the villages which are diverse geographically, ecologically, in cropping pattern, in sources of irrigation, land use and distribution, tenurial arrangements, as well as in the access to education, employment opportunities, in availability of farm inputs and in government programmes to help farmers and landlords." (E.S.C.A.P. Mimeo, p.5)

Information on households was collected on a basic set of variables in each village concerning households' demographic, economic, social, cultural and perceptional characteristics.

A careful examination of the questionnaire used by the research team at Quaid-e-Azam University indicated that sufficient quantitative as well as qualitative information had been collected to enable the analysis of most of the issues outlined in Section 1. After consultation with the research team in Islamabad in 1978 it was agreed that a Pareto-improving arrangement could be arrived at which would give us access to data in exchange for coding, cleaning and arranging the data for a preliminary analysis. The Islamabad team further requested that we write reports based on the evidence they had collected within the framework of our research objectives for circulation in the Planning Commission in Islamabad and the regional offices of the I.L.O at Bangkok.

During the long and arduous task of coding and arranging data for the research team in Islamabad (spread over a period of four months from September 1978 to January 1979) we had the opportunity of getting a feel for the quality of data regarding reliability and consistency. It was learnt that amongst the nine villages surveyed by the team, the best data were available for the five villages of Punjab, where fieldwork had been supervised closely. Farmer response in these villages was enumerated very carefully. There were very few gaps in information. The reported values on inputs used on the farm and crop outputs produced were those generally expected in the region. There were few outliers. When exceptional values were reported (too high or too low) the unusual circumstances resulting in such values were noted. (For example, low output due to sickness etc..) In the unirrigated (barani) areas, of the three villages, Jatli, Khunda and Mandhar, the last is the least representative of the region because of severe soil erosion caused by deep and fast rivulets. For these reasons crop production is not very important and the village is heavily dependent on remittances from non-resident members of the village (overseas migration is a very common feature). For the purposes of our analysis, therefore, we decided to use data from the four remaining villages of Punjab. These are Khunda, Jatli, Mehdiabad and Chak. (See map on p. ix.)

A description of the villages

Khunda is the larger of the two barani (rainfed unirrigated) villages. It is situated in Tehsil Pindi Gheb of district Attock which is one of the less developed districts of Punjab. The village was chosen because it represents a very unequal pattern of land-holding along with high incidence of tenancy. The social and political life of the village is dominated by a few Maliks (big landowners)who own most of the land in the village and have strong connections in the Government. There is very little irrigation in the village. Persian Wheels may be seen frequently but their drawing capacity is small (the water table being 40-60 feet deep). Some of the big Maliks have started to invest in the construction of small irrigation dams on the seasonal rivers that pass through the village. There is very little use of modern inputs (such as high yield variety seeds, chemical fertilizers and tube-wells) due to the type of soil which is hard and rocky. The village has a fairly big bazaar with commercial activity which provides non-farm employment opportunities. The incidence of migration is high. Both seasonal and permanent migration takes place. The traditional source of employment has been the military but with the shifting of the capital of Pakistan to Islamabad (the capital was shifted in 1964 and is 40 miles North-east of the village, and there is a fast, reliable bus service) numerous other employment opportunities have sprung up. Temperatures in the summer rise up to 116°F - 118°F and in winter fall to 28°F - 32°F. Most of the rain falls in the monsoon months of July and August. In the winter frost often damages the wheat crop.

Our other barani village, Jatli, is very similar to Khunda regarding employment opportunities outside the village and climatic conditions. The village is approximately 30 miles South-east of Islamabad in Tehsil Gujjar Khan in district Rawalpindi. The pattern of land distribution, however, is very different from Khunda. Land is more equally distributed and the incidence of tenancy is low. A special feature of Jatli is that it is located in an area that was earmarked for special attention by the Government in its Integrated Rural Development Programme (1973-1980). The objective of the programme was to provide, intensively, extension services, credit facilities, H.Y.V. seeds, chemical fertilizers and agricultural implements in the area covered by the programme. It was hoped that such areas would become agricultural growth points which would set an example for the surrounding areas to emulate. (By 1980 the Government had changed. The new Government thought that the programme was too ambitious and drastically reduced budgetary allocation.) Jatli has very good road connections with Islamabad which resulted in frequent visits by senior Government officials. Consequently Jatli was turned into a model I.R.D.P. village. Thus, use of modern inputs in Jatli is very widespread. The fertile soil of the village has responded well to the inputs so that yields are exceptionally good. We chose this village as an interesting example of the productive potential in barani areas given concerted effort by the Government to remove the supply constraints on the use of modern inputs.

Both our irrigated villages, Mehdiabad and Chak, are located in district Lyallpur of Punjab. The district has been carved out of the Chenab Colony which was part of the Triple Project (1905-1917) undertaken by the British to irrigate vast tracts of land in the Indus basin (Spate and Learmoth, 1972). Despite the recent problems of water logging and salinity, this was a remarkable feat. The provision of canal water transformed the barren, semi-desert region into one of the most fertile in South Asia. Both Mehdiabad and Chak lie in Tehsil Toba Tek Singh in the district. The tenurial structures in the two villages are quite different and have been influenced by the settlement schemes pursued by the Government to give property rights to cultivators. Mehdiabad was settled under an old scheme (1890-95) by inviting large landowners from the older sub-montain districts of the province with the promise of large holdings. They came along with their tenants and settled down in the village. Thus in Mehdiabad the incidence of tenancy is high and the distribution of land unequal. The village has excellent soil which responds well to irrigation and modern inputs. The use of H.Y.V. seeds, chemical fertilizers and tube-well irrigation is widespread. An important tributary of the main canal in the region (lower Chenab canal) passes 3 miles from the village so that canal water is regularly available and is plentiful. Although the district headquarter , Lyallpur, is an important industrial city and is 35 miles away, the incidence of migration from the village is low. The village does not have good rail/road connections to the main highways.

Our other irrigated village, Chak 305, was settled more recently under a different scheme. (The unusual name of the village is the work of an unimaginative settlement policy.) There are no large landowners in the village. Land was auctioned in small lots of 5 to 25 acres. This is reflected in the current distribution of land. The incidence of tenancy is low. An important feature distinguishing Chak from Mehdiabad is that being situated at the tail end of the canal, the quantity of canal water is rather low. Also, the subsoil water is saline and unfit for irrigation. This has affected the cropping pattern in the village. Chak is well connected to the transport system and the incidence of migration is quite high.

Our brief description of the four villages indicates that although the villages are different from each other, each may be seen to represent important types of villages to be found in Punjab.

Data collected in the village studies go, in some respects, considerably further than the requirements of the empirical issues outlined in Section 1.1

that we propose to analyse. The objective of the E.S.C.A.P. study was to present a profile of relative poverty so that detailed income generating activities of all cultivating as well as non-cultivating households were carefully enumerated and quantitative data were collected in each village. Our concern in this thesis, however, is primarily with the cultivating households in the villages. Therefore, in order to save time and money we restricted ourselves to that data matrix in the villages that provides quantitative and qualitative information on the income generating activities of members of cultivating households only.

Table 1.1 gives the breakdown of cultivating households by tenurial categories in each of the four villages of Punjab that we shall study. The five main tenurial categories are owner-cultivators, share-cropping tenants, owner-cum-share-cropping tenants, fixed-rent tenants, and owner-cum-fixed-rent tenants.

Table 1.1

Number of households in different tenurial categories in the village

Tenurial Status / Village	Owners	Share-cropping tenants	Owner-cum-share-croppers	Fixed-rent tenants	Owner-cum-fixed-rent tenants	TOTAL
Khunda	135	42	-	16	-	194
Jatli	150	3	-	18	-	171
Mehdiabad	22	14	18	8	8	70
Chak 305	80	9	2	6	13	110
Total	387	69	20	48	21	545

As will be seen in the Table, not all tenurial categories exist in all villages and there is considerable variation in the incidence of each category in the villages. In the chapters that follow we shall attempt to explain this variation. It is quite likely that other combinations of tenurial categories exist, e.g. a tenant who rents in parts of his land on fixed-rent arrangements and the other on share-cropping arrangements. However, we did not come across such cases in our sample of farmers in the four villages.

The data collected from cultivating households in each village provide details of inputs used and outputs produced for each of the principal crops grown in the four villages. Additionally, we have quantitative information on incomes, assets, prices, indebtedness, the sources of inputs purchased and outlets of outputs sold. There is data also on the incidence of migration and remittances in each village. Altogether, the data matrix consists of 545 households and over 200 variables.

Khanewal

The data available in the village studies conducted by the research team at Quaid-e-Azam University provide valuable empirical evidence for the investigation of most of the issues outlined in Section 1. There are a few remaining issues, however, to which the village studies do not attend even indirectly. One such issue concerns details of the rental contracts. For example, no data were available on the inputs stipulated in the rental contract and the methods of contract enforcement. As we discussed earlier, these issues are vital in a discussion of tenancy since they determine the conditions which influence the relative efficiency of different tenurial contracts. There are other refinements regarding input use that have also been missed out in the E.S.C.A.P. survey. For example, the distinction between whether or not an input is used and the intensity of use is not brought out clearly. Time profiles regarding input use are also not available. This suggested the need to supplement available data by another survey. With this in view we conducted a survey of a carefully selected sample of cultivators in Khanewal Tehsil in Punjab (see map on p. x.).

An important consideration in choosing Khanewal for our survey was that the farmers in our sample, selected from the Tehsil as a whole, are in many ways similar to the farmers in the two irrigated villages, Mehdiabad and Chak, discussed earlier. We have pointed out that Mehdiabad and Chak were chosen in Tehsil Toba Tek Singh because they are representative of the villages in that Tehsil. Similarity to the general characteristics of this Tehsil, therefore, is important in our decision to choose Khanewal. Thus we hope that some of the conclusions that we arrive at after discussion of the evidence in Khanewal carry over to the two villages as well.

There are many similarities between Toba Tek Singh and Khanewal Tehsil. Both are relatively recently settled canal colonies (Toba Tek Singh was settled between 1890-95 while Khanewal was settled in 1915-20). There are considerable within Tehsil variations regarding settlement so that both old as well as new canal colony villages are found in both Tehsils. The tenurial patterns (in themselves determined by settlement schemes) are quite similar in the two Tehsils. There are considerable ecological similarities as well. Being located adjacent to each other there is little variation in climactic conditions of the two Tehsils. Both are dependent on canal irrigation. Again, there are within Tehsil variations of irrigation intensities (we have seen that Chak is less intensively irrigated then Mehdiabad. This variation was kept in view while choosing our village in Khanewal). Cropping pattern is also similar in the two Tehsils with wheat being the main rabi crop and cotton the main kharif crop. Sugarcane, a year-round crop, is also widely grown in both Tehsils. The incidence of the use of modern inputs is quite high in both Tehsils. Because of similarities in soils, varieties of fertilizers and modern seeds used in the two Tehsils are quite similar. In both Tehsils the use of tube-well irrigation and tractor cultivation is widespread, (Pakistan Census of Agriculture 1972. Special Report Selected Data by sub-divisions).

It may be argued that the supplementary data ought to have been collected in the four villages discussed earlier. This was not done because it was considered desirable to broaden the base of the data for our discussion of tenancy contracts. Also, it may be methodologically unsound to return to the same villages with a different research team. The villagers may have had their fill of 'questionnaire-bearing outsiders' after the long stay of the Quaid-e-Azam University research team. Also, Khanewal is more easily accessible to the principal researcher. His family's association with the Tehsil smoothed out many administrative difficulties of access to 'Patwaris' whose help and advice were necessary in obtaining the appropriate sample of cultivators. It is unlikely, however, that this may have resulted in a reporting bias in the sample, since the farmers were chosen on the basis of reliability of response and co-operation. Influence due to family associations was absent at the village level.

Khanewal Tehsil has 44,821 farms spread over 396 villages cultivating 628,767 acres. Administratively, Khanewal is divided into four thanas which are Khanewal, Jehania, Mianchannu and Talamba. Most of the villages in the first three thanas are new canal colony villages while the majority of the old villages - situated along the Ravi river bed - are in Talamba. For the purposes of land revenue (levied by the Government) the soil in Khanewal has been divided into four major categories. These are called Beas, Ganjibar, Ottar and Hattar. Keeping in view our requirements of selecting representive villages (with regard to the distribution of farms, soil types, tenurial pattern, irrigation facilities and the use of new inputs), we consulted the record keepers, 'Patwaris', attached to the office of the Assistant Commissioner, Khanewal, for identifying villages from which we selected our sample of farmers. After careful discussions regarding representativeness on the basis of soil fertility, cropping patterns, tenurial arrangements, access to public transport and the use of modern inputs we decided to choose 11 villages from the Tehsil. These are given in the Table below.

Table 1.2 Villages chosen in Khanewal

Thanas / Villages	Khanewal	Jehania	Miachannu	Talamba
	168/10-R 88/10-R 23/10-R	157/10-R 114/10-R	133/15-L 66/15-L	17/8-R Pukka Haji Majid Kot Barkat Ali Basti Santpal

The numerical names given to canal colony villages have been frowned upon by sensitive settlement and revenue officers even during the British Colonial rule (see, for example, M.L. Darling (1934)). R and L refer to, respectively, the left and right bank tributaries of lower Bari Doab canal which is the main irrigation channel in the Tehsil. In Talamba three of the villages are situated along river Ravi and have existed for a long time prior to the introduction of canals. Here the names are derived from tribal chiefs and religious heads.

There are four tenurial categories that are of interest to us in studying tenurial contracts and changes brought about in them by the introduction of new technology. These are:

1. Share-croppers who have neither increased nor decreased the total area they rent in in the five years prior to the survey.

2. Share-croppers whose average rented in land has decreased in the five years prior to the survey.

3. Self-cultivating landowners who have not resumed land for self-cultivation from share-croppers in the five years prior to the survey.

4. Self-cultivating landowners who have increased their size of holding through resumption of land from share-croppers in the five years prior to the survey.

In order to get a sufficiently large sub-set of cultivators in each tenurial category to perform statistical tests of significance, we decided to interview 3 cultivators in each village belonging to the first two tenurial categories and 2 cultivators in each village belonging to the last two tenurial categories. Thus in each village we interviewed 10 farmers 1/ .

The village Patawari's advice was of great help in guiding us to the villages. Once in the village we arranged a meeting with the cultivators in the 'baithak' (front room in the house where visitors are received) of the 'lambardar' who is usually a respected cultivator in the village. We explained the objectives and the nature of the survey to the assembled cultivators. They then discussed among themselves and determined the respondents suitable for the categories of cultivators that were of interest to us. Usually, the respondents they recommended were very

---

1/. In Talamba this procedure was used in village 17/8-R but not in the other three villages. Instead we chose two share-croppers (one in each category defined earlier) and one self-cultivating landowner each from Pukka Haji Majid and Kot Barkat Ali. The remaining four respondents (two share-croppers and two landowners) were chosen from Basti Santpal. (This procedure was used because in each of the former villages one family owns all the land. In Basti Santpal, on the other hand, land holdings are small and ownership is dispersed). In this manner we hoped to capture the tenurial arrangements in the old pre-canal colony villages.

co-operative. We hoped that this method of selecting our sample of farmers would minimize any reporting biases.

The respondents thus selected enthusiastically answered our questions in long and laborious questionnaires which enabled us to collect data on nearly 400 variables giving us qualitative as well as quantitative information on tenancy contracts and input use. The field survey was spread over four months - from January to April 1979 and was conducted with the help of two local graduates.

It is clear that our sample of cultivators in Khanewal has been selected purposively rather than randomly. Further, we have used both personal as well as official contacts to seek out cultivators who were willing to sit through long interviews (taking up to 5 hours per respondent). Many arguments may be made for and against this procedure. The decisive argument for us in choosing this procedure was the shortage of time and a tight budget that did not allow for a sample sufficiently large for non-response not to matter.

We are satisfied with the quality of data collected in the field survey. The qualitative information on the nature of tenurial contracts is fairly exhaustive. There are very few cases of non-response. Most cultivators have given details of crop output and inputs used on the farm. Random checks of the reported values indicate that they are generally in conformity with those suggested by field workers of the Government extension services in the area.

The data base resulting from our field survey in Khanewal is quite large. Only some of the information has been processed for the purpose of this thesis. We hope to use other valuable data at a future date in extension of our research on issues discussed in this thesis. Some of these issues will be indicated in the concluding chapter.

Section 1.3 An outline of the structure of the Study

The chapter-wise layout of the thesis is as follows.

In Chapter 2 we shall examine the theories underlying the four main issues that we shall be concerned with in this thesis. As indicated in Section 1.1 these are production efficiency, tenancy, technology and migration. We shall first examine the debate on the size-productivity relationship. This will be followed by a discussion of the so-called Marshallian and Cheungian arguments regarding tenurial efficiency and the role of environmental uncertainty in determining the choice of the tenurial contract. Next we shall briefly discuss the history of technical change in Pakistan's agriculture and its likely impact on the size-productivity relationship. Finally we shall discuss the theory explaining rural-urban migration. The role of rural-end variables in determining migration will be examined. We shall argue that there may be a relationship between technical change and migration.

In Chapter 3 we shall describe the rural factor markets in our four villages and in Khanewal. The important factor markets that we shall consider are land, tenancy, credit and labour markets. A detailed examination will be made of the characteristics of agents participating in the four markets. An important objective of our discussion in this chapter will be to determine whether linkages exist between markets which may influence resource allocation on the farm. Our discussion will provide a rich background for each village in the context of which our ensuing detailed analysis will be conducted.

The first main issue that we shall address ourselves to in the formal analysis of our data is production efficiency in the four villages. This will be the topic of our discussion in Chapter 4. We shall present estimates of the size-productivity relationship and examine direct evidence from the villages to suggest explanations for our results. For each village we shall also estimate production functions with three inputs. This will allow us to comment on the relative intensity of the use of the three important inputs in different size-categories of farms.

Tenancy will be discussed in Chapter 5. Relative efficiency of different tenurial contracts will be examined and different criteria for evaluating efficiency will be discussed. We shall present a discussion of the variables that are important in explaining the incidence of tenancy. This discussion will enable us to examine the interaction between land, labour and bullock markets that may be important in explaining the existence of tenancy.

In Chapter 6 we shall discuss the impact of modern technology on production in our four villages. Inputs characterising the new technology in the villages and in Khanewal will be discussed and the importance of size and tenure in determining access to inputs will be examined. We shall present a time profile of modern input use for our sample of farmers. Finally, we shall present the results of a covariance analysis, in which the use of modern inputs will be regressed on the important characteristics of farmers in our sample.

Chapter 7 will be introduced with a discussion of the extent of migration amongst the cultivating households in our villages. We shall discuss the hypotheses underlying our empirical migration function in which village-end variables explaining rural-urban migration are given importance. On the basis of the available evidence in the villages we shall present a very general discussion to determine whether the characteristics of migrants suggested by the hypotheses can be verified. This will be followed by a more rigorous analysis using the probit method to evaluate the probability elasticity of migration of the 'representative' household in each village with respect to the characteristics indicated by our hypotheses. Our discussion in the chapter will allow us to suggest linkages between urban labour and rural credit markets in an environment of technological change.

Finally, in Chapter 8 we shall attempt to integrate our analysis by linking up the conclusions of each of the four issues that we shall have examined. Some of the important policy implications emerging from our analysis will be discussed. We shall conclude by making suggestions for further research.

CHAPTER 2

The theory and review of literature

Section 2.0 Introduction

In the present chapter we shall outline the theoretical background of the empirical issues to be investigated in Chapters 4 to 7. The major theoretical issues will be stated critically with the objective of suggesting testable hypotheses. Some existing evidence on the hypotheses will also be discussed. In the chapters that follow we shall concentrate on the empirical issues and frequently refer to the theory presented in detail in this chapter.

An analysis of production on the family farm allows us to identify both the technological frontier of the farm as well as the institutional arrangements that determine factor proportions on the farm. The farmer's choice of a particular point on the production possibility frontier is indicative of the transactions in the factor markets and the combination of inputs given the level of technology. Clearly, imperfections (as well as interactions) in the factor markets and the perception of environmental uncertainty are important in determining this choice. A detailed analysis of the production arrangements on the farm, therefore, is likely to provide valuable information on the working of rural factor markets.

In Section 2.1.1 of this chapter we shall review the literature in which the important issues concerning production efficiency have been discussed. We shall begin by reviewing the Indian debate on the relationship between size and productivity. Empirical evidence concerning the relationship and the theoretical arguments concerning land and labour markets that explain the relationship will be discussed in this section. Allocation of resources in an uncertain environment will also be considered as a possible explanation. The theoretical problems of the definition and measurement of economic efficiency and the estimation of production functions will be examined in Section 2.1.2.

There are three broad categories of contracts under which agricultural production is organised. These are owner self-cultivation, fixed-rent contracts and share-cropping tenancies. In Chapter 5 we shall use data from Pakistan to examine empirically the relative efficiency of the different contracts. We shall also estimate the degree of influence exercised by factors that determine the choice of a contract. In the present Section, however, our main concern lies with the theoretical arguments underlying these two issues. In Section 2.2.1 we shall assume that agricultural environment is certain while our discussion in Section 2.2.2 takes it into uncertainty.

Technological change influences labour markets in an important way. Markets for new inputs develop along with markets for input services. For example, tractors may be hired and tube-well water purchased. Adjustments are made in factor markets because of the expected gains in production as a result of the introduction of new technology. We shall discuss technological change in Section 2.3.1. The meaning of new technology and the existing pattern of its diffusion will be examined. In Section 2.3.2 we shall examine the likely impact of the introduction of new technology on size-productivity relationship. We shall postpone the discussion of the likely impact on tenancy to Chapter 6 where empirical issues will be taken up in greater detail.

Finally, the theory of rural-urban migration will be presented in Section 2.4. We shall first outline the standard rural-urban migration models in which migration is seen to result from a differential between urban and rural incomes. Empirical investigations based on such models emphasise the urban-end variables. We shall argue that there is a need to investigate rural-end variables closely. With this in mind we shall review two models that suggest the theoretical plausibility of an empirical rural-urban migration function in which rural-end variables matter.

In our concluding chapter (Chapter 8) - after we have described the markets as they operate in our four villages and in Khanewal and the empirical investigation of the four issues has been completed - we shall construct an argument that will bring out the linkages between the four issues outlined in this chapter.

Section 2.1 Production

Section 2.1.1 Size-Productivity Relationship

An important and much discussed issue concerning production arrangements in developing agriculture is the relationship between size and productivity. The discussion in the literature is a good illustration of interaction between theory and empirical data. Several theoretical insights about the working of rural factor markets were developed in the process of analysing data in India. These insights are invaluable in the determination of policies such as land reforms, co-operative farming and the structure of input subsidies in agriculture.

The first major contribution to the debate on the relationship between farm size and productivity was made by Sen (1962, 1964, 1966). On the basis of his analysis of the Farm Management Survey data[1/] he observed that by and large in Indian agriculture output per acre declines as the size of holding increases. He discussed this result in terms of a behavioural model of the peasant family farm where labour is allocated beyond the point where the marginal product equals the market wage rate. This result may be explained in terms of lower disutility of work on family farms so that the opportunity cost of labour is lower than the market wage rate. Another explanation for the inverse relationship

---

1/. Farm Management Surveys were launched by the Directorate of Economics and Statistics, Government of India, in 1955-56. Villages were chosen in five typical States of India (Punjab, West Bengal, U.P., Bombay, Madras) by a multi-stage stratified random sampling procedure using both cost accounting and survey methods. The surveys were conducted for a number of years.

suggested by Sen is the difference in the quality of land on the small and large farms. A historical-demographic argument is used to suggest that, compared to large farms, a greater percentage of land on small farms is of good quality because fertile soils can support a large population which results in greater subdivision of land (hence the concentration of small farms) on such soil.

The basic nature of the relationship between size and productivity as well as the two main explanations suggested by Sen resulted in considerable controversy. Sen himself cautioned against generalising these results since they are based on average yields in each size-category of farms, so that variations in yields across farms in each size-category are ignored. Earlier, C.H.H.Rao (1963) had suggested that a reliable test of the nature of the relationship would require an analysis of individual holdings. Such an analysis was undertaken by Khusro (1964) and C.H.H.Rao (1966) using regression analysis for farm level data. Their results confirmed Sen's observation.

The measure of land use in defining farm size is quite important in the relationship. The earlier studies used total cultivated area as a measure of farm size. If, instead, gross cropped area (which allows for double cropping on the total cultivated area) is used to measure farm size, the inverse relationship is weakened considerably so that the results cannot be generalised for India as a whole (A. Rao, (1968), A. Rudra(1968a, 1968b)). The appropriate measure of farm size for determining the relationship is the total cultivated area since an important reason for higher productivity on small farms is the greater intensity of cultivation which results in double cropping. By taking gross cropped area as a measure of size that aspect is not captured with the result that farm size and productivity appear to be unrelated (C.H.H. Rao, (1968)).

A version of this argument suggests the absence of the inverse relationship for specific crops since the distinction between gross and net cultivation is no longer relevant when acreage for each crop is considered (K. Bharadwaj,(1974)). This hypothesis was tested by Bliss and Stern (1980). They found that for most crops output is proportional with acreage. They also report that gross value of output is proportional to size. This may be due to the absence of large farms and close supervision of tenanted plots so that the various hypotheses (to be discussed below) advanced as explanations of the inverse relationship are not relevant for their sample of farmers.

The second round in the debate on the nature of the relationship resulted in an excellent paper by Bhattacharia and Saini (1971), in which they used disaggregated farm level data in several villages chosen from different Sates in India and established that when cultivated area is used as a measure of farm size output and productivity are generally inversely related. Their results are based on the estimation of partial and rank correlations at the village level. Sign tests are then used to determine the overall effect. After experimenting with various functional forms it is argued that the log linear functional form is appropriate for examining the relationship. A surprising result is that the inverse relationship between farm size and productivity is weakened for farms chosen from different villages. This appears to contradict the implication of Sen's land based hypothesis that suggests that the inverse relationship is more likely to be observed for farms chosen from different villages since the quality of land is likely to vary more within the sample of farmers thus selected.

While there appears to be some sort of a consensus in the early literature on the nature of the relationship between farm size and productivity there is much disagreement on the hypotheses advanced as explanations for the inverse relationship.

Sen's labour based hypothesis discussed earlier has been interpreted in various ways and challenged by several writers. Sen suggests a duality in the labour market on the basis of a distinction between family and hired labour whereas Mazumdar, (1963), distinguishes between slack period and peak period supply functions. In the slack period opportunity cost of family labour is low since the probability of getting employment is low. This lowers the labour supply curve for the annual crop year on small family farms resulting in a greater allocation of labour and thus raising output per acre on such farms. Another reason for a dualistic labour market may be the psychic costs of working for other people which reduces the attraction of labour outside the family farm.

A test of the labour based hypothesis may be devised by splitting up the sample of farms into pure labour hiring and pure family farms and then examining the size-productivity relationship for the former. Such a test was carried out by C.H.H. Rao, (1966).[1/] The inverse relationship was seen to hold for the labour hiring farms as well which led Rao to reject the labour based hypothesis. However, this test is not conclusive particularly when there may be other explanations for the inverse relationship based on hypotheses to be discussed presently.

A correct procedure for testing the dualistic structure of the labour market is to evaluate the marginal product of labour on farms distinguished on the basis of size and then compare the estimated marginal products with the market wage rate. For the hypothesis to hold marginal product on small farms (large farms) should be lower than (equal to) the market wage rate. Using this procedure Bardhan (1973) concluded that the

---

1/. A size-proxy was used to distinguish between labour hiring and family farms on the assumption that, on average, large farms hire in more labour than small farms.

estimated marginal product is greater than the average wage rate on many small as well as large farms. However, these results should be interpreted with caution since the production function may be misspecified due to the exclusion of bullock labour. It is quite likely that some of the influence of the excluded variable has resulted in a biased elasticity coefficient of labour (Sen, 1975).

Like land, labour is also sensitive to measurement. Thus whether labour is measured in manhours, mandays, the number of labourers or in terms of farm activities, has important consequences for both the magnitude of the coefficient as well as its statistical significance (Bliss and Stern (1980)).

Sen's land based hypothesis justifying the existence of an inverse relationship between farm size and productivity employs a historical-demographic argument for explaining the higher concentration of good quality soil on small farms. An alternative is the distress sales argument which suggests that at times of distress farmers sell the poorest quality soil. (It is not obvious to us they would do so. If a farmer wishes to raise Rs 1000 he may be indifferent between selling two plots of Rs 500 each or one plot of relatively better quality land.) Usually large farms buy such land so that these farms have, on average, not only poorer quality soil as compared to the small farms but are also more fragmented. Fragmentation lowers productivity because it stretches fixed factors such as supervision and increases the cost of digging irrigation ditches etc. (Bhagwati and Chakravarti (1971)).

A test for the land based hypothesis requires correction for soil fertility either by standardising the measure of farm size in acres on the basis of land revenue yields or by introducing a variable such as the percentage of farm area irrigated and then observing whether the elasticity coefficient of land approaches the value of unity. Khusro

(1964) and C. H. Rao (1966) use these procedures and confirm indirectly the validity of Sen's land based hypothesis.

Irrigation is a very labour intensive activity. It requires careful supervision at the time of actually irrigating the fields. More importantly, it is closely connected with other farm labour activities, such as sowing, fertilizing and weeding. For these reasons irrigation is likely to be correlated with labour. Correcting for irrigation , therefore, involves elements of both land as well as labour based hypotheses.

It is not clear whether the greater concentration of good quality soil on small farms is 'inherent' or the result of more labour effort on such farms. After all, the quality of soil can be improved with good husbandry. Thus there may be an element of overlap in the land and labour based hypotheses.

The allocation of higher labour input on small farms may be explained as rational response by the farmer in the presence of uncertainty. Srinivasan (1972) has modelled such behaviour. He argues that a farmer has a choice between cultivating land which is a risky asset and seeking employment in the labour market where the wage rate is known with certainty. A farmer's total income is given by

$$Y = Q + w\left[\bar{L} - aHl_1 - (1-a)Hl_2\right] \qquad (1)$$

and $$Q = H\left[a\ f(l_1)r_1 + (1-a)\ f(l_2)r_2\right]$$

where Q is total output from land

w is the certain wage rate in the labour market

$\bar{L}$ is the total own supply of labour

H is the total available land

l_1 is labour per acre on irrigated land

aH	is total land under irrigation
$(1-a)H$	is total land not under irrigation
l_2	is labour input per acre on unirrigated land
$r_1 > r_2$	are the random returns on irrigated and unirrigated land respectively
$f(\,)$	is a concave production function having constant returns to scale in labour and land, and is the same on irrigated and unirrigated plots of land

The farmer's objective function is to maximise the expected utility from (1) by allocating labour on the two types of land, i.e.

$$\max_{l_1, l_2} \quad E(U(Y)) \tag{2}$$

First order conditions of (2) imply that the farmer will allocate more labour on irrigated land as compared to unirrigated land. Since in equilibrium:

$$\frac{w}{f_1^1} = \frac{EU'r_1}{EU'} \equiv r_1^* \tag{3}$$

$$\frac{w}{f_1^2} = \frac{EU'r_2}{EU'} \equiv r_2^* \tag{4}$$

where f_1^1 is the marginal product of l_1

f_1^2 is the marginal product of l_2

Next, using Arrow's postulates when returns are risky, it is assumed that absolute risk aversion ($\equiv R_a(Y) = \frac{-U''(Y)}{U'(Y)}$) decreases when wealth increases and relative risk aversion ($\equiv R_r(Y) = -\frac{U''(Y)Y}{U'Y}$) increases when wealth increases. Using these assumptions a comparative static exercise gives $\frac{\partial l_i}{\partial H} < 0$ i.e. labour input on all types of land decreases when the farmer's total endowment of land increases. It is also shown that labour input is an increasing function of a, the proportion of land under irrigation and $\bar{L}$, the farmer's own labour. It is then argued (quoting evidence from India) that small farms have relatively larger $\bar{L}$ and greater a, so that, they allocate more labour input per acre as compared to the large farmers.

In the analysis, Y, the farmer's wealth, consists of a safe asset, labour, which is sold at given wage rate w in a certain labour market, and a risky asset, land. It is implicit in the results that an increase in wealth is considered to be the same as an increase in the endowment of land. As land increases, risk increases in a linear relationship to land. In this sense uncertainty in the model is multiplicative. This, in turn, implies that relative risk aversion is important in determining the allocation of resources and it is this that gives the result, $\frac{\partial l_i}{\partial H} < 0$.

Bliss and Stern (1980) have shown that if a farmer's wealth increases as a result of an increase in the endowment of a safe asset (e.g. non-farm income or rent from fixed-lease tenancies) absolute risk aversion is important in determining choice. This gives us a result opposite to that of Srinivasan so that, as a farmer's wealth increases due to an increase in the safe asset, he uses more variable inputs per acre. This argument is implicit in Srinivasan's analysis where it is shown that $\frac{\partial l_i}{\partial \bar{L}} > 0$, $\bar{L}$ being the safe asset in (1).

Section 2.1.2 Efficiency

Implicit in the size-productivity discussion presented in the previous section is a concept of efficiency. The empirical conclusion that inverse relationship exists between output per acre and the size of holding has been used as evidence to suggest that small farms are more efficient than large farms. A number of studies have interpreted this result as indicative of diminishing returns to scale in Indian agriculture. This may be a valid approach in an agricultural system where most of the variation in output is explained by land alone. However, South Asian agriculture is going through a period of technological change that is characterised by capital and labour constraints. Therefore, the use of a single input such as land in the measurement of efficiency and returns to scale is unsatisfactory (Farrell (1957)).

The use of the total value of capital on the farm (Khusro (1974), U. Patnaik (1972)) as a measure of size or scale of operations is equally objectionable since a single input is still being used to compare efficiency of different farms. The biases pointed out by Farrell operate here as well. It is interesting to note Patnaik's (1972) results that suggest an inverse relationship between size and productivity when land is used as a measure of size and a positive relationship when the measure of size is the total value of capital used on the farm. An implication of these results is that within any homogenous size category of farms there may be considerable variation in efficiency when it is measured in terms of output per acre. This may be due to differences in managerial efficiency and attitude to new technology amongst farmers in the same size category in terms of land ownership.

The production function

An analytical technique that allows us to comment on both returns to scale as well as relative efficiency of small and large farms requires the estimation of production functions (Farrell (1957)). The theoretical problems associated with specification and estimation of production functions need a detailed discussion. This will be taken up in

Chapter 4. For the moment we shall concentrate on some empirical results.

Using Indian data Saini (1971), Sidhu (1974) and Bardhan (1973) estimated returns to scale by adding up the elasticity coefficients of the inputs specified in a Cobb-Douglas production function. They report that, in general, constant returns operate in Indian agriculture. Similar results have been reported for Pakistan (Aslam (1978)). The four studies also report diminishing returns to land. This casts some doubt on the assertion that a fixed coefficient production function is appropriate (C.H. Rao (1966)).

Production function analysis allows a straightforward test for the relative efficiency of small and large farms, holding inputs such as land, human labour, bullock labour, irrigation, fertilizer and other capital inputs, constant. This method isolates managerial abilities and other unmeasured factors, as explanations of differences in efficiency. The usual procedure is to determine an appropriate distinction between farms on the basis of size and then to use a dummy variable in the production function. Junankar (1976) used this procedure in his study of farms in India. On the basis of his tests he concluded that there is no difference in efficiency between small and large farms given that they have the same production function. For Pakistan, Aslam (1978), reports that small farms have a higher intercept term than large farms which suggests that small farms are relatively more efficient. His results are based on the use of farm size as an independent variable in crop specific production functions.

The use of production function analysis to comment on the relative efficiency of different farms size categories assumes that the estimated coefficients are reliable. This assumption has been questioned (Nowshirani (1967), Wallis (1973)) since the equilibrium levels of the inputs specified in the production function are derived as a result of profit maximization. This may imply that the quantities of inputs used are not independent of the error term and, therefore, the estimated coefficients are likely to be biased. (A detailed discussion of these issues is presented in Chapter 4.) An alternative procedure is to estimate input elasticities by using profit functions.

Profit functions

The profit function expresses the dependent variable (profit) as a function of input prices and fixed inputs (McFadden (1970)). Specific production functions such as Cobb-Douglas production function may be used in the actual estimation (Lau and Yotopoulos (1971)). Using a size dummy in a profit function Lau and Yotopoulos (1971) find that small farms are relatively more efficient compared to large farms in Indian agriculture. Junankar (1976), on the other hand, reports no significant differerence between the two farm sizes. Using Pakistani data (Aslam (1978) reports that the small farm dummy is positive and statistically significant suggesting that this farm category is more efficient than the large farms.

The data requirements for estimating profit functions are quite stringent. The evaluation of input prices paid by different farms is not easy. Further, the distinction between fixed and variable inputs is rather subtle and, in practice, quite arbitrary. These problems are reflected in estimation. Lau and Yotopoulos (1971) report a negative sign of the coefficient for capital while Junankar (1980) reports a positive sign for the coefficient of wages paid out to hired labour. It is quite likely that these 'incorrect' signs are due to misspecification.

Section 2.2.1 Tenancy without uncertainty

The fixed-rent contract

We shall begin by describing the equilibrium for owner-cultivators and fixed-rent tenants. Suppose the production function is given by $F(H,L)$ where H is land and L is labour. Assuming that a competitive market for land and labour exists, the opportunity cost of land is R and that of labour is w. The cultivator maximizes output in agricultural production subject to the market determined opportunity costs, i.e.

$$\underset{L\ H}{\text{Maximize}} \quad F(H,L) - wL - RH \tag{1}$$

The equilibrium conditions are :

$$\frac{\partial F}{\partial H} = F_1 = R \tag{2}$$

$$\frac{\partial F}{\partial L} = F_2 = w \tag{3}$$

(2) and (3) describe competitive equilibrium where land and labour markets are cleared. Using these results economists have tried to determine whether share-cropping tenancies are equally efficient in allocating resources.

Share-cropping inefficiency:

Marshall suggested that share-cropping tenancies could be inefficient in resource use. He argued :

> ".....when the cultivator has to give to his landlord half of the returns to each dose of capital and labour that he applies to the land, it will be not be to his interest to apply any doses the total return to which is less than twice enough to reward him. If, then, he is free to cultivate as he chooses, he will cultivate far less intensively than on the English plan (i.e. fixed rent tenancies) ....." (Book VI, Chapter X, Section 4)

The result derived by Marshall using partial equilibrium analysis may be represented mathematically in terms of the maximizing problem presented in (1). Now if r is the share in output received by the landowner, the share-cropping tenant's maximand is :

$$\underset{H,L}{\text{Maximize}} \quad (1-r)\ F\ (H,L) - w\ L \tag{4}$$

The freedom to choose H and L results in the following 'equilibrium' conditions :

$$(1-r)F_1 = 0 \tag{5}$$

$$(1-r)F_2 = w \tag{6}$$

(5) implies that in 'equilibrium' $F_1 = 0$ since $(1-r) > 0$. Thus there is excess demand for land whenever the marginal product of land is positive and since there is little evidence to suggest that $F_1 = 0$ (6) implies that the share-cropping tenant will allocate less labour than in (3) again because $(1-r)>0$. Thus when the maximand is given by (4) labour is allocated inefficiently, intensity of cultivation is less and so is output per acre, compared to the solution for owner-cultivators and fixed-rent tenants.

Share-cropping efficiency :

(5) and the lack of evidence to support the result that the marginal product of land equals zero, taken together, suggest that landowners have some bargaining power while negotiating tenurial contracts. One manifestation of this power may be that they do not have to accept returns from share-cropped land less than those from alternative use of land. Thus one can argue that in equilibrium

$$rF = SH \tag{7}$$

where $SH \geq RH$ is the opportunity cost of land and S is some attractive rent to the landowner.

A landowner who self-cultivates a part of his land could ensure that a share-cropper performs at least as well as he does on his self-cultivated land through periodic checks on performance. One way to achieve this is to contract short term leases. (The intention here need not necessarily be to have a high turnover rate of tenants but to maintain the threat of eviction if share-croppers apply insufficient inputs.) With this consideration the share-cropping tenant's maximand is

$$\underset{H,L}{\text{Maximize}} \qquad F\,(H,L) \; - \; SH \; - wL \tag{8}$$

Now the equilibrium conditions are

$$F_1 \; = \; S \tag{9}$$

$$F_2 \; = \; w \tag{10}$$

The landowner's total income is

$$SH + F\,(H',L) - wL + R(\bar{H} - H' - H) \tag{11}$$

where H' and L are land and labour used in self cultivation and $\bar{H}$ is the total available land. In equilibrium

$$\frac{\partial F}{\partial H'} \; = \; R \; \leq \; S \; = F_1 \tag{12}$$

$$\frac{\partial F}{\partial L} \; = \; w \; = \; F_2 \tag{13}$$

R may be less than S by a factor representing costs of management incurred by the landowner in supervising the share-cropping tenants. The landlord is not free to make S as large as he likes since the share-cropping tenant has the option to bid for fixed rent tenancies or sell all his labour in the labour market. As we shall see below he may also mix contracts.

It is clear by the analysis presented above that the landowner's bargaining power implied by (5) enables him to devise contracts that result in allocative efficiency. The duration of the lease discussed above is one method. Alternatively land may be rationed. If F, the production function, varies across tenants, landowners may discriminate against less productive tenants while contracting land. If F is the same for all tenants, land may be parcelled. Both rationing procedures imply that landowners have considerable bargaining power while allocating land so that we must revise the assumption that tenants are free to choose land and labour as implied by (4).

A problem with the model that gives the allocatively inefficient solutions (5) and (6) arises on account of the empirical evidence suggesting that share-cropping tenancies are <u>at least</u> as efficient as fixed-rent tenancies (Cheung (1969), Herring (1979), Bliss and Stern (1980); also see the results presented in Chapter 5). Considering these results and the superior bargaining power implied by (5), it may be argued that landowners can dictate the use of inputs on share-cropped tenancies to bring about efficiency. Marshall certainly seems to be aware of this since he goes on to argue in the section quoted above :

> ".....by constant interference the landlord can keep up the amount of labor he (the tenant) puts on his farm, and keep down the use he makes of the farm cattle for outside work, the fruits of which he does not share with the landlord ....."

It is argued, further, that the landowner can ensure appropriate intensity of cultivation

> ".....if the tenant has no fixity of tenure the landlord can deliberately and freely arrange the amount of capital and labour supplied by the tenant....."

The model presented in (8) captures the above argument.

The bargaining power of the landowner enables him to maximize the rent that he receives from share-cropping. This may be achieved by an apprppriate combination of the chosen values of the rental share and the number of tenancies contracted since the total income of the tenant from share-cropping must not fall below the income he could earn by selling his labour. This is illustrated in Fig.2.1 where only two tenants are considered.

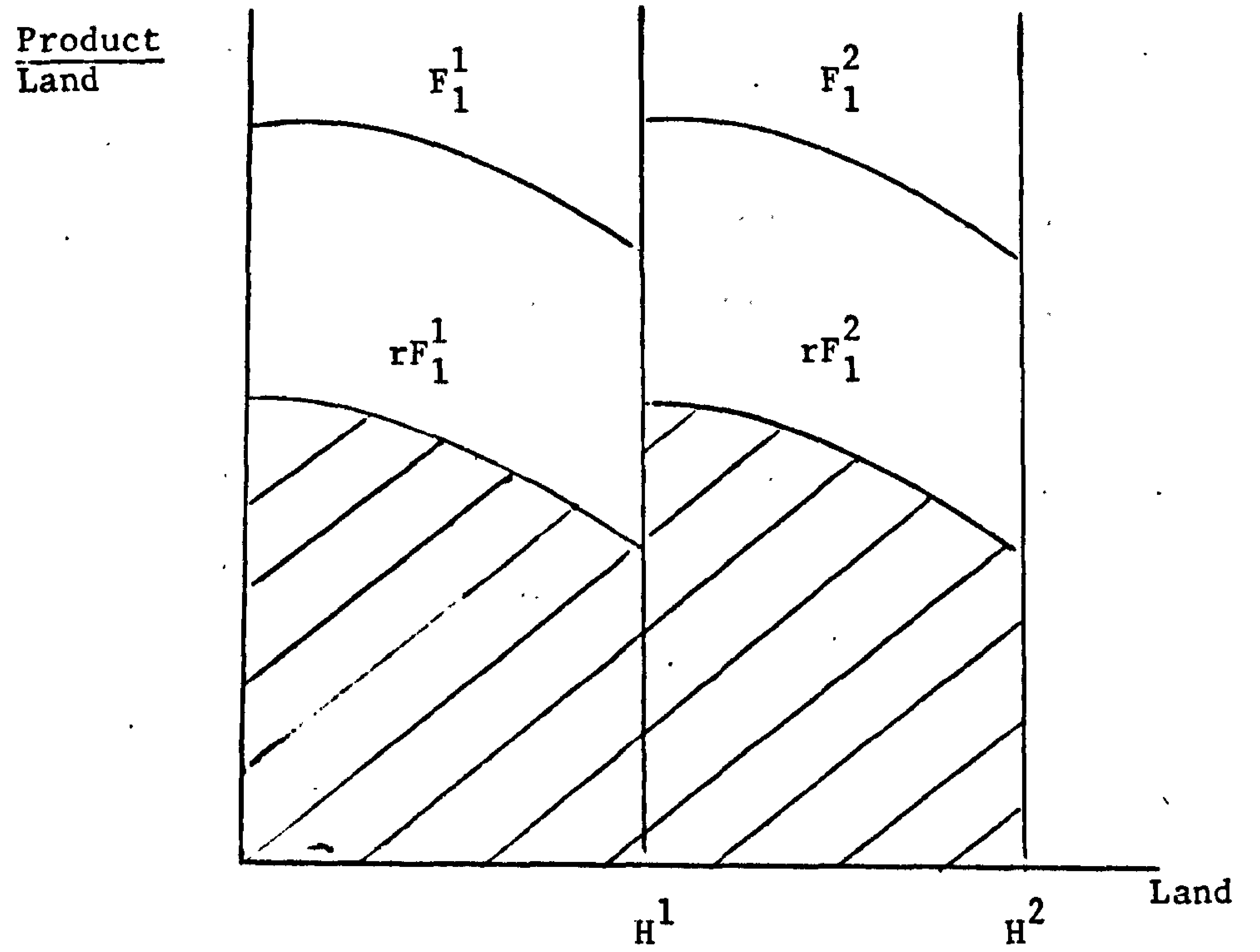


Fig. 2.1

In Fig. 2.1 the total rent received by the landowner is given by the shaded area. To maximize this the landlord minimizes $T = (1-r)\left[F_1^1 + F_1^2\right]$ which is the income of the two tenants subject to the constraint that it is at least equal to $w(L^1 + L^2)$, the opportunity cost of the tenants' labour. A landowner could increase the total shaded area by dividing up land into more than two plots. However, without an adjustment in r this will lower tenants' income relative to alternative income opportunities, and they will opt out for other employment.

To see the allocative properties of the model presented in Fig. 2.1 we shall state the problem mathematically.

Landowner's objective function is :

$$\text{Maximize} \qquad R = nrF(\tfrac{H}{n}, L) \qquad (14)$$

by choosing n , r and L

where n is the number of plots into which landowner's holding is sub-divided.

The constraint may be represented by

$$\text{For each tenant} \quad (1-r)\ F\ (\tfrac{H}{n}, L) \geq wL \qquad (15)$$

Assuming that the constraint binds and substituting, the landowner's maximand, given by (14) and (15), may be re-stated as :

$$\text{Maximize} \quad n \left[F\ (\tfrac{H}{n}, L) - wL \right] \qquad (16)$$

First order conditions give :

$$\frac{H}{n} F_1 = \frac{R}{n} \qquad (17)$$

$$\hat{F_2} = w \qquad (18)$$

(18) implies that labour is allocated efficiently and (17) means that rent from each share-cropped plot equals the marginal product of land on the plot.

We, therefore, have allocative efficiency similar to that on fixed rent tenancies. With appropriate modification in (14) and (15) these results are easily generalised to inputs other than labour. If $\underset{\sim}{P}$ and $\underset{\sim}{x}$ are the vectors of input prices and inputs other than labour respectively, the landowner's maximand is :

$$\underset{r, L, n, \underset{\sim}{x}}{\text{Maximize}} \qquad nrF(\tfrac{H}{n}, L, \underset{\sim}{x}) \qquad (19)$$

$$\text{subject to} \quad (1-r)\, F\,(\frac{H}{n}\,,\, L\,,\, \underset{\sim}{x}) - \underset{\sim}{P}\,\underset{\sim}{x} \geqq wL \tag{20}$$

Upon substituting from the constraint we have :

$$\text{Maximize} \qquad n(F - \underset{\sim}{P}\,\underset{\sim}{x} - wL) \tag{21}$$

and the first order conditions are :

$$\frac{H}{n}\, F_1 = \frac{R}{n} \tag{22}$$

$$F_2 = w \tag{23}$$

$$F_i = P_i \tag{24}$$

Again, we have allocative efficiency.

Cost sharing

The model represented in (4) assumes r to be fixed and allows the tenant to make the allocative decisions. We saw in (5) and (6) that this leads to allocative inefficiency. In the model represented in (14), on the other hand, the allocative decisions about the rental share r, the number of plots and the amount of stipulated labour are made by the landowner subject to the constraint of tenant's foregone income through wage contracts. Evidence from Pakistan (which we shall discuss in Chapter 3) suggests that, typically, the rental share is fixed and cost sharing is widely practised. We shall next consider the effects of incorporating these two features in our share-cropping models.

Landowner's income from rent needs to be adjusted to take into account his share in the cost of production. We shall assume for simplicity that only labour costs are important and these costs are shared by a proportion α by the landowner. Assuming r to be fixed landowner's problem may be written as :

$$\underset{n,L,\alpha}{\text{Maximize}} \quad n\,r\,F - \alpha\,n$$

subject to

$$(1-r)\,F + \alpha \geq w\,L \tag{25}$$

Assuming that the constraint binds, we have

$$r\,F - \alpha = F - w\,L \tag{26}$$

Now the maximand may be re-written as

$$\text{Maximize} \quad r(F\,(L, \frac{H}{n}) - w\,L) \tag{27}$$

Now the problem is similar to that in (16) and we have efficiency in share-cropping.

Bliss and Stern (1980) have shown that more general cost sharing arrangements, in which the landowner agrees to share the costs of a vector of inputs chosen by the share-cropper, result in input levels which can be shown to be the same as achieved by stipulation. They show that the optimum share with cost-sharing is less than that for stipulation although the net rent is the same.

We may summarize the discussion of this section with the help of Table 2.1.

The table indicates that inefficiency arises only when the tenant is allowed to make allocative decisions regarding land and labour. We have seen, however, that such a situation does not define equilibrium. The excess demand for land under such an arrangement gives the landowner bargaining power in determining the contract. This bargaining power results in arrangements all of which are efficient in resource allocation.

Table 2.1 Tenurial arrangements influencing efficiency in resource use

Allocative decision maker	Choice of variables		
	land, labour	rental share, land, labour	cost share, land, labour
Share-cropper	inefficiency	efficiency [a]	efficiency [b]
Landlord	-	efficiency	efficiency
Fixed-rent tenant	efficiency	-	-

a : with landlord determining rental share

b : with landlord determining cost share

Our analysis of share-cropping contracts without uncertainty indicates that different tenurial contracts can be shown to be equally efficient in resource allocation. Our analysis does not tell us why different contracts coexist. It is instructive to speculate on some of the determinants of the choice of a rental contract under certainty.

It can be seen from Table 2.1 that whenever tenants are free to choose inputs whose costs are not shared with the landowner there is likely to be inefficiency. Let us consider the circumstances under which this is likely to occur.

The first circumstance is when tenants have security of tenure so that they cannot be evicted. This may happen due to strict Government legislation. Such legislation often contains the clause that the tenant must cultivate land efficiently. However, this clause is rather difficult to implement. Such a situation would take us straight to the case described by Marshall (in the first quote). Clearly, fixed-rent contracts will be preferred by landlords.

In our analysis so far we have assumed that there are no enforcement costs of share-cropping contracts. This, of course, is not true. Efficient share-cropping contracts require the stipulation of more than one variable input and periodic evaluation. This requires detailed supervision which is costly. Supervision costs are determined not just by the wages of the "munshi" (bailiff) since most landowners are aware that "munshis", in turn, need to be supervised.

Costs are likely to vary across landlords depending on foregone opportunities. For a local shopkeeper, who rents out land, the cost may be the trade lost during the period of supervision. However, for landowners whose profession requires them to reside in towns (e.g. land-owning lawyers, doctors, etc.) the opportunity cost of supervising efficient cultivation is quite high. An extreme example is that of the absentee landowner for whom the opportunity cost of supervising land may be very high. Consequently, the absentee landowners may be unable to stipulate inputs. This results in inefficiency. Under these circumstances fixed-rent contracts may be chosen.

The persistence of share-cropping contracts characterized by inefficiency reported in several empirical studies (Bell (1977)) may be explained by the argument above that assumes fixity of lease.

Other reasons for choosing share-cropping contracts may arise on account of the functioning of rural credit markets whereby landowners, and through them the tenants, are allowed access to capital. We shall take up this discussion in detail in Chapters 5 and 6. Share-cropping contracts also enable tenants to share the superior managerial skills of the landowners (acquired through their contacts with the Government extension services). Similarly, landowners may decide that they can spread their skills through share-cropping more easily than through direct supervision of hired labour.

Section 2.2.2 Uncertainty and tenancy

Our discussion of tenurial contracts without uncertainty indicated that under fairly plausible conditions share-cropping contracts may be shown to be as efficient as fixed-rent tenancies and owner-cultivation. We then discussed the circumstances under which share-cropping contracts became more attractive to landowners and tenants compared to other contracts. The prevalence of these circumstances may explain the popularity of such contracts in countries like Pakistan. We shall now introduce uncertainty into agricultural production and discuss its implications for the choice of rental contracts.

Uncertainty in crop production implies that output on the farm is a random variable which may be influenced by factors other than the cultivation practices of the farmer. Given this uncertainty and given also risk aversion, farmers will allocate resources in such a manner that risks associated with the returns on their investments on inputs like seeds, fertilizers, water and labour time are minimized. Thus resource allocation on the farm may be influenced in an important way by factors such as the size of farm and the nature of the rental contract because they affect risk aversion. In Section 2.1 of this chapter we discussed the influence of the size of farm on resource allocation under uncertainty. In this section we shall discuss the role of rental contracts in risk dispersion.

We shall first briefly consider the nature of risk dispersion that may be achieved with the three important rental contracts that concern us. Under owner-cultivation the entire risk of decisions regarding resource allocation on the farm are borne by the cultivator himself. Under fixed-rent tenancies landowners and tenants decide on the rent and fix it at the beginning of the crop season so that the entire risk is borne by the tenant. Under share-cropping tenancy, however, although the share proportion is determined at the beginning of the crop season, the actual value of crop output going to the landowner and the tenant is determined after the harvest. This implies that the risk is shared between the landowner and the tenant. Thus given uncertainty , the attraction of share-cropping contracts is that they enable the sharing of risk associated with the allocative decisions regarding crop production.

We shall next discuss some of the circumstances under which share-cropping contracts become redundant. We shall then argue that in the real world these circumstances may not prevail so that share-cropping may be an attractive contract for risk averse landlords and tenants.

Share-cropping may become redundant if effective crop insurance exists in the agricultural sector. By paying a premium, owner-cultivators and fixed-rent tenants could insure themselves against poor yields. However, crop insurance in Pakistani agriculture is virtually non-existent for a number of reasons including the moral hazard problem. Given the range of crops grown and the small size of holdings, it is likely to be difficult for the cultivator and the crop insuring institution to agree on the nature and degree of risk.

Another situation in which share-cropping becomes redundant is when tenants can combine fixed-rent contracts with wage contracts (the cultivator bears all the risk in the former and no risk in the latter contract) so that the risk dispersion achieved by such a combination of contracts is the same as that achieved by share-cropping contracts. To see this, let us consider a tenant who has a production function given by $\Theta F(H, L)$ which displays constant returns to scale. If he allocates $(1-r)$ units of land and labour to cultivation under fixed-rent tenancy and sells r units of labour at the going wage rate, his income is given by:

$$\left[\Theta\, F(\,(1-r)\, H,\, (1-r)\, L\,) \;-\; R(1-r)\, H \;+\; wrL\right] \qquad (28)$$

Since we have assumed constant returns to scale,(28) may be written as:

$$(1-r)\,\Theta\, F(H,\, L) \;-\; R(1-r)\, H \;+\; wrL$$

or

$$(1-r)\,\Theta\, F(H,\, L) \;+\; \left[wrL \;-\; R(1-r)\, H\right] \qquad (29)$$

The first expression in (29) is the tenant's income under share-cropping tenancy. It equals (29),i.e. the income with a mixed contract, only if the expression in the square brackets equals zero. This happens when :

$$wrL \;=\; R(1-r)\, H \qquad (30)$$

or

$$\frac{RH}{wL} \;=\; \frac{r}{1-r} \qquad (30)$$

which implies that factor shares under mixed contracts should be the same as the distribution of the share of output between landowner and the share-cropping tenant.

Now if share-cropping is introduced in a system with given values of rental R and wage rate w , then the only possible values of crop share r are those that satisfy (30) (Newbery (1976)). A higher value of the share going to the tenant (landowner) would be unacceptable to the landowner (tenant) since the alternative of mixing contracts according to (28) is always possible. Newbery also shows that the competitive wage-rent equilibrium is efficient in the sense of Pareto optimality with respect to <u>ex-ante</u> expected utility. Thus if share-cropping is superimposed on the efficient rent-wage system,then according to (30) share-cropping is redundant.

There are a number of reasons why mixing of the two contracts may not be as attractive as share-cropping in the real world. The first set of reasons arises on account of costs involved with a successful mix of contracts. Each of the two contracts is likely to involve search. The time required for finding contracts that allow an appropriate mix of the two contracts may be fairly long. This may imply high search costs so that tenants may opt out for share-cropping. A similar argument applies for landowners. However, in their case, costs of search may be relatively lower since - as we have seen in the previous section - share-cropping contracts involve supervision (enforcement) costs.

From the landowner's point of view the relative attraction of share-cropping contracts will be influenced by the nature of uncertainty. If uncertainty is multiplicative, share-cropping contracts may be redundant provided (30) holds. However, if uncertainty enters the production function sequentially, share-cropping contracts may have certain advantages. Sequential uncertainty implies that agricultural production involves different activities at different time periods and that the outcome of past activities can be influenced by decisions in the current activity. For example, if insufficient rain falls after sowing, yields may be improved through irrigation at a later stage. Self-cultivation with hired labour may require very close supervision by the landowner to ensure that appropriate tasks are performed when the contingencies arise (Reid (1974)). On the other hand, share-cropping contracts may be free from detailed specification of tasks and therefore are better suited to meet such contingencies.

Another approach to uncertainty in agriculture distinguishes choice uncertainty from outcome uncertainty (C.H.H.Rao (1971)). The two aspects of outcome uncertainty - multiplicative and sequential - have been discussed above. Choice uncertainty refers to the risks associated with entrepreneurial decisions. Such decisions assume importance when output is produced for the market and choices have to be made regarding the appropriate crop mix when prices fluctuate and about the schedule of delivery of the produce to the market. Subjective evaluation of risky investments plays an important role here and it is likely to vary across individuals. The problems of moral hazard may prevent successful share-cropping contracts between landlords and tenants particularly under the plausible assumption that risk aversion is a function of wealth. Thus in regions where choice uncertainty is important - in regions where a wide range of crops can be grown - fixed-rent contracts may be preferred.

Throughout our analysis we have assumed a perfectly competitive, certain labour market. A number of arguments may be advanced to suggest that labour markets are less integrated than the neo-classical paradigm assumes. For instance, tenants may attach high costs to working for other farmers so that traditional cultivators may be unwilling to work as wage labourers on other farms. For such cultivators the risk dispersing option of mixing fixed-rent contracts with wage labour may not exist.

Assuming that the desirability of working for others is not very different from the desirability of working for oneself, there is still the problem of uncertainty in the labour market. The tenant may not find as much work as he likes at the going wage rate within a reasonable distance of his tenanted plot, or the wage rate itself may be random. Both these uncertainties in the labour market may make share-cropping contracts more attractive.

Section 2.3.1 Technological change

The technological change initiated in the mid-sixties in the agricultural sectors of several developing countries is called the "Green Revolution" by optimists. However, there is a pessimistic view as well. Pessimism with the technological change stems from concern with problems of initiating and sustaining the spread of new technology (Falcon (1970)) and the impact on income distribution (Byers (1972), Griffin (1974)). Two views prevail amongst the optimists. The first sees the Green Revolution as a Hirschman-like phenomenon applied to agriculture whereby the introduction of a new input, high yield variety seeds, starts a chain reaction that ultimately pushes out the production possibility frontier of the entire economy. Empirical evidence from South Asia suggests that this is a considerable exaggeration of the impact of the new technology (Griffin (1974)). A more realistic view is that in regions where the complementary input, irrigation, is available, some new strains of crops such as wheat and rice have registered dramatic increases in yields. This has resulted in widespread adoption of the new technology, increasing the total value of food production. This, however, may have worsened income distribution where land is concentrated amongst a few large landowners and factor market imperfections work out to their advantage. In this section we shall discuss the likely impact of technological change on the relationship between farm size and productivity.

'Green revolution' technology is defined by inputs such as high yield variety seeds, fertilizers and water. The new technology has been introduced for a number of crops such as wheat, rice and more recently tobacco and cotton. The initial success story with the most dramatic consequences, however, was wheat. Several Mexican dwarf wheat varieties were tried in research stations in Pakistan in 1961. The potential for the successful spread of the new variety in the ideal soil and climatic conditions of the Indus Basin were soon realised. By 1965 a modest beginning was made by sowing

12,000 acres of dwarf wheat. By 1974 nearly 8.5 million acres were sown with the new variety which is sixty per cent of the total area sown with wheat (Griffin (1974)).

Dwarf wheat varieties have a short growing period, short stems and excellent tillering. With proper fertilization and irrigation water, yields per acre were doubled compared to the traditional varieties, resulting in a growth rate of wheat production of nearly nine per cent (Griffin (1974)).

In order to encourage the use of new high yield varieties of wheat, the Government subsidised inputs such as seeds, fertilizers and tube-wells. Price support programmes were initiated to enable farmers to get high returns without increasing the price of food in the urban centres. To sustain this success, investment was made to set up research stations for continued improvement in crop strains. The Ministry of Agriculture started an ambitious extension programme in order to provide information to farmers on the scientific methods of cultivating the new varieties.

We shall now examine the hypothesis that given market imperfections the introduction of technological change is likely to increase the difficulty of access to inputs by small farmers (Griffin (1974)). Both direct and indirect methods were used by the Government to introduce high yield varieties in Pakistan. Appeals were made to large farms directly by functionaries of the Ministry of Agriculture. In a field survey conducted in Khanewal, Lowdermilk (1972) reports that Government extension workers visited large farms more frequently than small farms. At the same time seeds, fertilizer and tube-well irrigation were made available at subsidised rates at specific distribution points. We shall examine how the latter method is likely to affect the rural factor markets.

The pattern of the location of distribution points may favour large landowners to the extent that they are usually located in small rural towns where large landowners already have interests due to residence or political ambitions. The marginal cost of transporting inputs for them may be close to zero. The small farmers, on the other hand, have to make several trips that involve both travel costs as well as the opportunity cost of a day's labour on the farm. Usually, the distribution points are regulated by Government bureaucracy in order to ration the new inputs that are in short supply. Large landowners with better contacts are able to jump queues. Small farms, on the other hand, have to incur higher 'transaction' costs.

Another method of encouraging the use of new inputs is to provide subsidised credit. This method works to the advantage of large landowners particularly due both to the 'transaction' cost element discussed earlier and the ease of access to Government loan giving institutions. It may be argued that this policy channels scarce capital into less productive use, since larger farms with easy access to credit may use the loan to purchase tractors (we shall discuss this in detail in Chapter 6).

It may be argued that uncertainty prevailing in agriculture may also contribute to differential access to new inputs. Investment in new inputs is likely to be risky since returns are unknown. To the extent that large landowners are less risk averse due to their greater wealth, they are more likely to use new inputs compared to the small farmers.

Thus it seems plausible that encouraging the use of new inputs through subsidies and rationing results is worsening the factor market imperfections faced by the small farmers. This suggests that small farmers are less likely to adopt new technology. Empirical data from

Pakistan, however, does not substantiate this. Lowdermilk (1972) reported that although large farms initiate the use of new inputs, small farms catch up (in 2-3 years in his sample of farms from Khanewal), so that ultimately there is no significant differerence due to farm size in growing new dwarf varieties of wheat. Griffin (1974) has given evidence from a number of countries which shows that both small as well as large farmers adopt the new technology. Salam (1978) has given evidence from a sample of farms across different districts of Punjab in Pakistan which also suggests no difference in input use due to farm size.

How can we reconcile the evidence to the argument of differential access to inputs ? One explanation may be that because of its impact on yields of food crops, even small farmers find it attractive to invest in new inputs. This raises demand encouraging the growth of intermediaries who make inputs available at a price lower than the opportunity cost at Government distribution points. Thus village 'arhtias' and shopkeepers often sell fertilizer and/or lend cash to the small farmers. These intermediaries may be prepared to meet transportation and transaction costs of inputs particularly if high yields of food crops releases land for growing more cash crops which they purchase. Thus new technology, instead of worsening the functioning of rural factor markets, may in fact improve its working. This does not show up in quantitatively measurable variables since the change is both subtle and quite complex. The incentive for the growth of intermediaries may not necessarily be the difference in the price of inputs but rather the increase in revenues through commissions earned on the tied purchase of crops grown on land released from food crops.

It may be argued that small farmers are discouraged from adopting new technology due to the adverse distribution of sources of irrigation.

Where irrigation is regulated by the Government through a network of public canal irrigation, access to water is relatively more equal. But subsidy on tube-wells that favours large farmers may worsen the distribution of irrigation water (Falcon (1970)). In Pakistan however, most tube-wells have excess capacity which is utilized by the larger farmers by selling water to the small farmers who do not own tube-wells. Thus a lively market in tube-well water has emerged that passes on some of the benefits of Government subsidy to the small growers. Similar markets operate for hiring tractor services.

Many large holdings in Pakistan are divided up into small plots and rented out to share-cropping tenants. The introduction of new technology may be encouraged by landlords by sharing costs of new inputs. Such risk sharing tenurial arrangements reduce the riskiness of new technology thus spreading its use. This is substantiated by Lowdermilk (1972) from evidence in Khanewal where he found that tenant operated farms adopt new technology more readily compared to owner operated farms in comparable size categories.

Our discussion suggests three explanations for small farmers' intensive use of the new inputs associated with the 'green revolution' technology. These are: growth of intermediaries, the development of markets for factor services and the cost-sharing role of the landlord on tenanted farms. In Chapter 6 we shall consider the evidence regarding input use for our sample of farmers in the light of these explanations.

Section 2.3.2 Impact of technological change on the size-productivity relationship

A number of studies, e.g. Bhattacharia and Saini (1971) in India and Salam (1978) and Khan (1979) in Pakistan, report that with the introduction of new technology associated with the 'green revolution', the size-productivity relationship has changed, since large farms with greater access to new inputs have higher yields than small farmers. These results, however, need careful scrutiny. In their study, Bhattacharia and Saini (1971) report a positive relationship between farm size and productivity for farms studied in the post-green revolution years. In their calculations they have used the gross crop acreage as a measure of size. We have already noted in Section 2.1 the problems associated with such a measure. Salam's results are most curious since his reported tables show that small farms use new inputs either more intensively than large farms or have comparable intensities. His conclusion, therefore, that as a result of the 'green revolution' technology,"the previously known phenomenon of relatively higher crop yields per acre on the small farms as compared to large farms, prevailing under traditional agriculture is disappearing" does not follow from the evidence he has presented.

We shall empirically test the argument that 'green revolution' technology results in reversing the traditional inverse relationship between size and productivity. This will be done both in Chapter 4 as well as in Chapter 6. In Chapter 4 we shall estimate production functions and comment on the intensity of use of modern inputs in the light of our values of estimated marginal products. We shall compare returns to specific inputs with returns to scale to discuss resource allocation on small, medium and large farms in our four villages. In Chapter 6 we shall examine the direct evidence on use of modern inputs in the villages. This analysis will enable us to determine directly whether size is important in determining the intensity of use of inputs such as fertilizer, tube-well irrigation and ploughing with tractors.

Section 2.4 Rural-urban Migration

In the present section we shall review models of rural-urban migration. Models of migration, typically, (e.g. Barnum and Sabot (1975), Greenwood (1969), Levy and Wadycki (1972) etc.) are concerned with the following migration function :

$$M = f\,(d,\ \underset{\sim}{x}) \qquad (1)$$

where M measures the number of migrants. The important argument in the functional relationship is d which measures the present value of the expected income differential between urban and rural areas for potential migrants.

$$d = \sum_{t=1}^{n} \frac{\left[Y_u(t) - Y_R(t)\right]}{(1+r)^t} \qquad (1')$$

where Y_u is expected urban income, Y_R is expected rural income, r is the interest rate and t is the time subscript that takes values 1.......n. All other economic variables relevant to the migration decision such as the cost of job search, cost of transfering residence and the cost of living differences between urban and rural areas are subsumed in $\underset{\sim}{x}$. (Other important variables determining migration such as costs of cultural adjustment, psychic costs of working in an urban environment etc. are also subsumed in $\underset{\sim}{x}$.)

The migration function (1) is such that

$$\frac{\partial f}{\partial d} > 0 \text{ with } \lim_{d \to 0} f(d,\ \underset{\sim}{x}) = 0$$

These models perceive migration as a process of adjustment in the labour market. The argument is that if we take the labour market of the economy as a whole, wage differentials between rural and urban labour markets result in labour moving from low wage rural areas to high wage urban areas and this results eventually in an equilibrium in the economy-wide labour market. Allowing for uncertainty the Harris-Todaro (1970) condition in the economy-wide labour market may be expressed as

$$P\,W_m = W_a \tag{2}$$

where W_m is the wage in the urban sector labour market, W_a is the wage in the rural labour market from which the migrant comes and P is the perceived probability of finding a job in the urban sector.

The equilibrium condition (2) allows us to compute the rate of unemployment in the urban sector with the assumption that the perceived probability of finding a job in the urban sector is given by :

$$P = \frac{E}{E + U} \tag{3}$$

where E is the number of jobs in the urban sector and U is the number of unemployed workers in that sector. The model described above makes certain assumptions about the urban labour market. One is that the periodic job selection process is random whenever the number of available jobs is exceeded by the number of job seekers. Another is that all jobs are turned over in each period. It is also assumed that the urban sector labour markets are homogeneous.

Given W_m, W_a and E we can solve for U since (2) and (3) together imply that

$$\frac{E}{E+U} = \frac{W_a}{W_m} \tag{4}$$

Typically, in developing countries the ratio $\frac{W_a}{W_m}$ equals $\frac{1}{3}$ or $\frac{1}{4}$ (Turnham (1971)) so that (2) gives urban unemployment rate of 67% or 75%. This would appear to be a considerable over-estimation given that measured urban unemployment in LDC's is below 10% (Stern (1977)).

More recently, extensions of migration models have been carried out in an attempt to get reasonable predictions of urban unemployment. The assumption implicit in equation (3) of the model above, that all jobs are turned over in each period, has been examined critically by Johnson (1971). He introduces work-sharing arrangements between employed and unemployed members of the migrant families in his model to get lower predicted unemployment levels in the urban areas.

A major extension of the basic model has been made by Fields (1974). He introduces expected utility as the potential migrants' maximand rather than expected income. This enables greater flexibility in the prediction of unemployment rates, since risk aversion of the individual is introduced into the argument. The model presents an explicit discussion of the perceived probability of finding a job. Features of the urban labour market like the existence of the informal sector and preferential hiring policies for specific groups, such as the educated migrants, are also considered explicitly in the extension.

An important objective of the recent modifications in the Harris-Todaro model is to identify variables that can be easily observed and measured so that econometrically testable migration functions can be specified. It is hoped that such specifications will result both in more realistic predictions of urban unemployment as well as in the identification of important variables for policy recommendations.

Several versions of the empirical migration functions based on the theory outlined above have been estimated. Broadly speaking, two methodological approaches have been adopted. In one, 'macro' migration functions are estimated. The dependent variable, usually, is the number of migrants (defined, for example, by their length of stay) in the urban areas (Greenwood (1971a)) or the ratio of migrants to the potential migrants in the source areas (Barnum and Sabot (1975), Huntington (1974), Levi and Wadycki (1972)) while the explanatory variables are the regional characterstics of rural and urban areas determined by the theoretical models. Although such 'macro' functions are important in determining variables that induce inter-sectoral migration (such as the difference in wage rates in the two sectors), they do not inform us about the characteristics of the migrant. Thus the distinction between the potential migrant and the decision to actually migrate is not brought out.

An alternative approach is to study 'micro' functions of migration. These functions enable us to determine the probability that an individual migrates. There are many examples of 'micro' functions in the literature on migration. We shall consider in detail Hay's study (1974) in Tunisia. The objective of our discussion is to establish a point of departure for our own empirical investigations to be presented in Chapter 7.

Hay's study is a good example of an empirical migration function based on models that are concerned mainly with the impact of migration on the urban job markets. Hay writes his migration function as :

$$M = f(S, Sk, INF, AGE, AGE^2, MAR, HAMAN, Yc)$$

where M takes value 1 for migrant, 0 otherwise.

S is years of schooling.

Sk equals 1 when the potential migrant has job learned skills, 0 otherwise.

INF equals 1 when the potential migrant knows someone in the urban areas before migrating, 0 otherwise.

MAR equals 1 for married migrants, 0 otherwise.

HAMAN equals the number of hectares per active man farmed by the potential migrant's household,

Yc is the annual cash income of the potential migrant from wages earned from non-farm employment in rural areas.

It is hypothesized that S, Sk, INF and AGE encourage migration while AGE, HAMAN and Yc discourage migration. No a priori predictions are made about the influence of MAR on migration.

It is not clear in Hay's migration function whether the potential migrant's decisions are based largely on his individualistic considerations or whether he is the head of household who decides for other household members as well,by moving the whole household to the urban areas. The model is concerned with explaining the probability of finding a job in the urban areas which, in turn, implies a concern with the urban-end consequences of migration. It is clear that in Hay's migration function, except for HAMAN and Yc , all the explanatory variables are urban-end variables in the sense that they determine the potential migrant's probability of finding a job in the urban areas. If we assume that the decision making unit for which Hay's migration function is relevant, is the individual migrant, the role of HAMAN is not clear. It may be interpreted as indicating that the potential migrant belongs to that class of cultivators for whom the land-man ratio has reached the critical level so that,as head of household,the cultivator is prepared to abandon cultivation altogether. But this implied pattern of migration is contrary to what is observed in many LDC's.

Empirical evidence from India and Pakistan (Stark (1975), Eckert (1972)) suggests that most of the migrants are unmarried, young and belong to cultivating households that continue to live in the village with crop cultivation as the major economic activity. Frequently, it is the recently matured son of the household who migrates (see Connell et al.

(1974)). Remittances from the migrant member to his household are commonly observed (Ali Mohammed (1973)). Thus the empirical evidence suggests that the decision to migrate may be a joint household decision, in which remittances from migrant members are seen as the result of an attempt to allocate joint household resources. This suggests a need to take a closer look at models that emphasize village-end variables in a migration function in which the unit of observation is a household with potential migrant members.

Empirical migration functions such as those of Hay discussed above are derived from models that specify income as the maximand rather than utility (see (1') above. If migration is the result of a decision to maximize household welfare, the distinction may be quite important. For example, an important variable subsumed in the vector $\underset{\sim}{x}$ of (1) may be the disutility due to the psychic costs of breaking up the household unit (even if it is temporary as Stark (1975) has argued). It is not clear then whether this important factor should be simply subsumed in $\underset{\sim}{x}$. In a more realistic theoretical model it ought to have a more active role. We shall next consider models in which both village-end variables as well as utility are taken into account explicitly.

We shall first consider a simple model of migration in which village-end variables are the ones that matter in arriving at decisions. The argument is usually made in terms of land-man ratio for a unit of observation (L.G. Reynolds (1969) and studies cited in J. Connell et al. (1974), Lipton (1976)). The argument may also be presented in terms of the available food per capita (Stark (1975)) where the observable unit is a cultivating household in the village. The production function is given by

$$F = g(H, L) \qquad (5)$$

where F is food, H is land and L is labour.

Let the rate of growth of population for the observed unit be n and m, the rate of migration. The rate of growth of labour force in the unit is (n-m) which is positive but less than n. We shall assume that the rate of growth of land is less than that of the labour force, i.e.

$$\frac{d(\log H)}{dt} < \frac{d(\log L)}{dt}$$

or to take a convenient special case

$$\frac{d(\log H)}{dt} = \gamma \frac{d(\log L)}{dt} \quad \text{for } 0 < \gamma < 1$$

Now change in the available food per worker is given by :

$$\frac{d(F/L)}{dt} = \left[\left(\frac{\partial F}{\partial L}\frac{dL}{dt} + \frac{\partial F}{\partial H}\frac{dH}{dt}\right) L - F\frac{dL}{dt}\right] \Big/ L^2 \qquad (6)$$

Now $$\frac{d(\log L)}{dt} = \frac{1}{L}\frac{dL}{dt} = n - m \qquad (7)$$

so that $$\frac{dL}{dt} = L(n-m) \quad \text{and} \quad \frac{dH}{dt} = \gamma H(n-m) \qquad (8)$$

Substituting (7) and (8) in (6) we have

$$\frac{d(F/L)}{dt} = \frac{(MP_L L + MP_H H \gamma - F)(n-m)}{L} \qquad (9)$$

Assuming that g displays constant returns to scale and $\gamma < 1$ the first expression of the right hand side of (9) is negative so that the condition for $\frac{d(F/L)}{dt}$ to be positive is $m > n$.

There is a simple intuitive argument underlying the model presented in equations (5) to (9). The argument is that typically, in rural economies, the creation of employment opportunities does not keep pace with population growth since land is in fixed supply. This results in a fall in the available food per capita within the economic unit. To check this from falling below some critical level, the unit encourages migration.

An interesting feature of the model outlined above is that migration may result primarily from the rural-end considerations such as the fall in available food per member in the economic unit below some acceptable critical level. This simple model has been extended and made more realistic in a number of ways by Stark (1975). We shall discuss his model next.

Stark begins by establishing the unit of observation in his model. He quotes evidence that suggests that typically a migrant is a young, unmarried male (often the recently matured eldest son) who has strong links with the rural household. These links are maintained after migration through a steady flow of remittances back to the family farm.

At any point in time the equilibrium for the household regarding its allocation of endowments of land and labour, is determined by the condition that the marginal utility of labour used to produce food on the family farm equals the marginal disutility of labour.

This static equilibrium of the household cultivating land with traditional technology is disturbed over time by the changing demographic structure of the family. The food requirements of a growing family increase with the result that the marginal utility of food rises over time. This process continues till the oldest son reaches maturity. At the time of his maturity the household may choose between allocating the maturing son's labour on the family farm or encouraging him to migrate to an urban job market. This decision depends crucially on the nature of the production function. It is argued by Stark that under traditional methods of cultivation, food output is inelastic with respect to labour. An alternative for the household, is to shift to a different production function characterized by new technology. Typically, inputs required by the new technology are high yield variety seeds and fertilizer.

Shifting to the new production function requires the existence of investable surplus as well as the ability to bear greater risk (if higher risks are associated with the new technology). If rural capital markets function properly the required surplus could be borrowed. Also if crop insurance exists, risks associated with the new technology may be dispersed. However, given that capital markets are notoriously imperfect and crop insurance does not exist, the twin objectives of accumulating investible surplus and risk dispersion may be achieved through migration. Remittances from the migrant sons provide funds for purchasing the new inputs and at the same time, by providing an alternative source of income, allows the household to disperse risks associated with the new technology. Assuming the existence of surplus labour on the farm an additional source of surplus may be the food foregone by the migrant son.

There are a number of stages in the argument where things could go wrong and the resulting surplus may not be as big as the model predicts. For example, the son may sever links with the family once he is in the city or he may not get a job and may have to be supported by his household for some time. Also, there may be considerable uncertainty in getting an urban job, so that risk dispersion may not be achieved perfectly.

The model discussed above may be contrasted with that of (1). It will be seen that the main difference lies in the relative importance given to the urban-end variables in the former and the village-end variables in the latter. Further, the decision-making process in the latter suggests joint household decisions while the models underlying (1) usually argue in terms of an individual migrant optimizing income or utility. The implications of the two approaches for empirical migration functions are also likely to be different.

In Chapter 7 we shall develop a migration function in which village-end variables are considered important. Using a dummy dependent variable we shall attempt to estimate the probability of a household having a migrant member. This will require a discussion of probit analysis which, we shall argue, is the appropriate procedure for estimating the probability of migration.

Section 2.5 Concluding Remarks

Our discussion in this chapter indicates some important theoretical and empirical aspects of the four issues that concern us in this study. For each of the issues we have traced the development of the theoretical arguments and indicated the main controversies. We also discussed some empirical evidence and methodological issues.

An important objective of our discussion was to present a theoretical analysis of the role of rural factor markets in the four issues discussed in this study. We argued that rural land and labour markets are important in explaining the relationship between size and productivity. Tenancy is also influenced in an important way by these two factor markets. We suggested arguments indicating that credit market is important for tenancy and also in determining access to modern inputs and that it may influence the size-productivity relationship as well. Similarly, rural-urban migration was discussed in the context of operations in labour and credit markets. The discussion has been presented to point out the importance of linkages between different rural factor markets and hence between the four issues that we propose to study. For example, we have argued that the issues of rural-urban migration and access to modern inputs are inter-linked through the working of rural credit markets. We shall refer to such linkages throughout our discussion in this study.

In this chapter we have presented the theoretical and empirical background for our more specific hypotheses that will be developed and tested using data from Khanewal and the four villages. Thus in Chapter 3 we shall look closely at the empirical evidence regarding factor market linkages. Size-productivity relationship and the hypotheses explaining it will be taken up in Chapter 4. The two theoretical positions regarding tenurial efficiency will be put to empirical test in Chapter 5. Access to technology will be the topic in Chapter 6 and, finally, a migration model that emphasizes rural-end variables will be developed and tested in Chapter 7. The discussion in these chapters will be presented with the objective of both testing the different theoretical positions indicated in this chapter as well as to suggest some new arguments.

CHAPTER 3

The Markets

Section 3.0 Introduction

A description of operations in the factor markets is important in providing the background in the context of which we shall present our analysis in the chapters that follow. In this chapter we shall describe the functioning of four important rural markets. These are markets for land, tenancy, credit and labour. We are using the word market, here, in a much wider sense than the interpretation usually given to it by economists. Thus we shall be concerned with a description of arrangements in land, tenancy, credit and labour markets by which resources exchange hands in our villages. We shall also present a description of the agents who participate in these markets.

In our discussion of the land market in Section 3.1 we shall be concerned with the distribution of land amongst the cultivating households in the four villages. We shall define our measure of farm area and compare its distribution with that of land owned by cultivating households in each village. Gini coefficients will be estimated to make these comparisons. We shall argue that tenancy markets are important in determining the re-allocation of land to make adjustments to factor endowments of cultivators. For example, there may be a high concentration of land amongst the large size farms if we consider land distribution by ownership alone. The distribution may be less concentrated if we take into account operational holdings. This may indicate that operations in the tenancy market enable cultivators with excess endowments of labour (given land) to enter into an exchange with others who have an excess of land (given labour).

Operations in the tenancy market will be described in Section 3.2

PAGE MISSING
IN ORIGINAL

This discussion will be based on evidence collected in our survey of farmers in Khanewal. Earlier (in Chapter 1) we discussed the usefulness of evidence from Khanewal for our discussion of the tenancy market. We argued that markets for tenancy in Khanewal are similar to those of the two irrigated villages, Mehdiabad and Chak. The discussion in this chapter is important as a background to the analysis of Chapter 5. Given that relevant information is not available in the two villages, data from Khanewal are useful in supplementing the evidence on tenancy from the other two villages. Our discussion of the tenancy market will provide evidence on the degree of competition amongst the potential tenants and landowners. This may indicate the relative bargaining power of share-croppers and landowners which, in turn, may influence the rental contract. We shall analyse the contract in detail. The objective will be to determine the procedure by which contracts are enforced to achieve tenurial efficieny. Thus, the choice of the inputs stipulated in the contract, the method of stipulation, the cost-sharing arrangements and the supervision practices of landowners will be the subject of our discussion in Section 3.2.

In Section 3.3 we shall present a discussion of the credit markets in our four villages and in Khanewal. Because of the difficulties of obtaining quantitative information on rural credit, our discussion will focus mainly on the qualitative information. We shall describe the agents involved in transactions in this market both on the supply as well as the demand side. We shall attempt to determine how rural factor markets are inter-linked. For example, we shall investigate the importance of landowners as a source of credit for tenants. We shall also determine whether agents control both commodity markets as well as the market for credit. We shall then comment on the difference between implicit and explicit interest rates. On the demand side, we shall investigate whether tenure and size are important in determining access to credit. Evidence will also be discussed in an attempt to distinguish between consumption and production loans.

Finally in Section 3.4 we shall discuss the available evidence in the three villages and in Khanewal on the operations in the labour market. Linkages between land and labour markets on the one hand, and between land and the commodity exchange markets on the other, will be discussed. Evidence on permanent hired labour and seasonal labour employment opportunities on farms of different sizes and for different crops will be presented.

Section 3.1 The land market

The distribution of land

A comprehensive measure of land distribution amongst the cultivating households in our villages will indicate a number interesting economic facts. The first is the distribution of assets in the village. Land is the most valuable asset on the farm compared to other assets such as the value of livestock, farm machinery and implements, and farm buildings. The proportion of the value of other assets to the value of land is quite low. Besides, the value of other assets is likely to be related to the value of land given the complementarity between the two. Secondly, the index of distribution of land amongst the cultivating households may reflect their relative social status in the village. This may determine access to inputs such as labour (through greater bargaining power) and other modern inputs (through access to the Government supply system). In the discussion that follows we shall focus on the distribution of land in the four villages.

Our measure of farm area throughout the discussion in this study is the operational holding. We shall define operational holding as land owned by a household plus land rented in minus land rented out. Thus our measure describes the farm area actually cultivated by households at the time of the survey. It may be called the net asset position of the hosehold where land cultivated is the asset and it takes into account the adjustments made by households regarding access to plots. For example, a household may own n plots of land and n-1 of these may be contiguous while the n^{th} plot may lie at a distance which may raise costs of cultivation (when plots are contiguous there are economies in digging irrigation ditches, ploughing, and protection of crops from stray livestock and theft). The households may decide to rent out this plot in exchange for a plot rented in from another household which may be nearer the n-1 plots. Plots may also be exchanged for their suitability for growing different crops. Also, plots may be of unequal soil fertility, so that exchange may result in a large plot being rented out and a comparatively smaller plot being rented in. Such exchange arrangements were widely reported in all four villages. Net land rented in (land rented in - land rented out) by households may also reflect adjustments to complimentary inputs such as family labour and draught power - given imperfections in the markets for complementary inputs. (This discussion will be taken up in detail in Chapter 5.)

An alternative way to look at land distribution in the village is to consider the distribution of land owned. We argued in Chapter 1 that the issues that we shall be concerned with in this study concern mainly the cultivating households in the villages so that we have not analysed data on non-cultivating households such as the absentee landlords, landless labourers and village artisans and shopkeepers. Therefore, it would not be very useful to discuss the distribution of land in terms of a measure such as land owned without taking into account households who lie at the extremes of the distribution and who are, usually, absentee landlords and landless labourers. Bearing this in mind, we shall present only a summary statistic (such as the Gini coefficient) of the distribution of land ownership amongst cultivating households in the four villages. Using this statistic we shall compare the distribution of land owned and land cultivated and comment on the role of the tenancy market in changing the distribution of land.

The distributions of operational holdings amongst the cultivating households in the four villages are given in Tables 3.1 - 3.4.

In Khunda (Table 3.1) there are 14 farms that cultivate less than 5 acres each. A majority of these are tenanted holdings where land is rented in from one of the three big 'Maliks' (landlords) who own land in the village. At the other extreme of the distribution there is one farm which spreads over 375 acres of good, fertile land. It belongs to one of the more 'progressive' self-cultivating 'Maliks'. Majority of the cultivators in the village lie in the 7.5 -12.5 size-category They are mostly owner-cultivators who cultivate, on average, about 11 acres each. Altogether they cultivate nearly 18% of the land in the village. 12.5-25.0 size-category is also prominent where nearly 30% of the farms and 26% of the land in the village is concentrated. Most of the farms here are owner-cum-tenant farms. The non-cultivating 'Maliks' in the village have been active in the national politics of the country. Both, because of the size of their holdings and their strong connections in the Government, they wield considerable influence in the village. They have successfully circumvented the three major land reforms [1/] introduced by the Government. However, there is a long

---

1/. The land reforms were initiated by the Government of Daultana (1951-52), Ayub Khan (1960-61) and Bhutto (1971-72).

Table 3.1 Distribution of operational Holdings* in Khunda

Size-category	Number of farms	Percentage	Acres	Percentage
Under 1 acre	-		-	
1.0-2.5 acres	4	2	5.50	0.13
2.5-5.0 acres	10	5	39.00	0.90
5.0-7.5 acres	17	9	115.35	2.67
7.5-12.5 acres	72	37	799.50	18.53
12.5-25.0 acres	57	29.5	1142.25	26.47
25.0-50.0 acres	22	11	778.10	18.02
50.0-150.0 acres	11	6	1061.20	24.58
Above 150 acres	1	0.5	375.00	8.69
TOTAL	194	100	4315.90	100

* Operational Holding = Landowned + Land rented in - Land rented out

Table 3.2 Distribution of operational Holdings* in Jatli

Size-category	Number of farms	Percentage	Acres	Percentage
Under 1 acre	15	9	11.87	0.99
1-2.5 acres	20	12	39.38	3.28
2.5-5.0 acres	67	39	257.26	21.43
5.0-7.5 acres	15	9	90.56	7.55
7.5-12.5 acres	34	20	324.25	27.00
12.5-25.0 acres	16	9	276.00	23.00
25.0-50.0 acres	2	1	60.00	5.00
50.0-150 acres	2	1	141.00	11.75
Above 150 acres	0	0	0	0
TOTAL	171	100	1200.32	100

* Operational Holding = Land owned + Land rented in - Land rented out

and interesting history of tenant-landlord struggle over tenancy and ownership rights in land in the village. A detailed account of this history is presented in a paper by a member of the Islamabad research team (see Nigar Ahmed (1980)).

Our other 'barani' village, Jatli, is a village of fragmented holdings with a large number of farms cultivating very small plots of land. Table 3.2 shows that 50% of the farms in the village cultivate less than 5 acres each. Altogether, such farms account for nearly 25% of the land in the village. At the other extreme there are two holdings in the village in the 50-150 acre size-category. Between them, they cultivate 12% of the land in the village. These are owned by families with a long tradition of serving in the military. Although their influence in the village is quite strong, there are fewer tensions between them and the rest of the cultivators as compared to Khunda. This is partly accounted for by the fact that they are mainly self-cultivators who do not rent out land on tenancy. Owner-cum-tenant farms are concentrated mainly in the 7.5-12.5 acre size-category. Altogether, 20% of the farms and 27% of the land in the village is cultivated in this size-category.

In Table 3.3 we have presented the distribution of operational holdings in Mehdiabad. It can be seen that nearly 20% of the farms cultivate less than 5 acres each. Altogether they cultivate 3% of the land in the village. At the other extreme are 7 farms, belonging to the descendants of Syed Mehdi Shah, who, between them, cultivate nearly 48% of the land in the village. Syed Mehdi Shah came to the village at the turn of the century soon after the area was settled by the British Government (previously he owned land in District Attock) and brought with him tenants as well as technical know-how. His farming practices were cited as an example to other farmers in the area by the

British revenue officers. He started his farm on an estate of 525 acres. Since then, more land has been added by his descendants to the total area originally cultivated. Some land is also rented in. The influence of the Syed family is an important factor in the socio-economic life of the village. Most of the cultivators in the village (33% of the total) belong to the 7.5-12.5 size-category and cultivate between them 17% of the land. A majority of the pure tenants in the village lie in the 12.5-25 acre size-category while most of the owner-cum-tenants are concentrated in the 2.5-5.0 acre size-category. The practice in the village is that large landowners (there are 9 non-cultivating landlords in the village) rent out land in large blocks to carefully selected tenants who are well-known for their husbandry skills. Typically, such tenants do not own any land of their own.

The distribution of operational holdings in our other canal-irrigated village, Chak 305, is presented in Table 3.4. There are a large number of medium-sized farms in Chak (45% of the farms cultivate 66% of the total area) cultivating on average 13.67 acres each. Another 40% of the farms cultivate less than 5 acres each. There is only one large farm in the village, cultivating about 52 acres of land. Because of this pattern of land distribution there is no dominant family in the village and the spirit of co-operation and mutual help is quite strong. The incidence of tenancy is quite low. Most of the tenants rent in land on fixed-rent tenancy and also own some land (see Table 1.1, Chapter 1). They are concentrated mainly in the 7.5-12.5 acre size-category.

Table 3.3 Distribution of operational Holdings* in Mehdiabad

Size-category	Number of farms	Percentage	Acres	Percentage
Under 1 acre	0	0	0	0
1-2.5 acres	6	8.57	11.25	0.75
2.5-5.0 acres	8	11.42	30.62	2.04
5.0-7.5 acres	8	11.42	51.66	3.44
7.5-12.5 acres	23	32.86	253.24	16.85
12.5-25.0 acres	11	15.71	204.15	13.58
25.0-50.0 acres	7	10.00	235.27	15.65
50.0-150.0 acres	6	8.57	542.00	36.06
Above 150 acres	1	1.43	175.00	11.64
TOTAL	70	100	1503.19	100

* Operational holding = Land owned + Land rented in - Land rented out

Table 3.4 Distribution of operational Holdings* in Chak 305

Size-category	Number of farms	Percentage	Acres	Percentage
Under 1 acre	3	2.73	3.00	0.29
1-1.25 acres	7	6.36	12.41	1.21
2.5-5.0 acres	34	30.91	131.00	12.74
5.0-7.5 acres	13	11.82	80.30	7.81
7.5-12.5 acres	33	30.00	339.63	33.04
12.5-25.0 acres	17	15.46	343.75	33.44
25.0-50.0 acres	2	1.82	66.0	6.42
50.0-150.0 acres	1	0.91	51.99	5.06
Above 150 acres	0	0	0	0
TOTAL	110	100	1028.08	100

* Operational holding = Land owned + Land rented in - Land rented out

We shall next discuss the summary statistic that we shall use to compare the distributions of operational holdings and land ownership in the four villages.

The measure that we have used to evaluate inequality of land distribution amongst the cultivators in our four villages is the Gini coefficient. It may be written as :

$$G = \frac{1}{2n^2\overline{H}} \sum_j \sum_i (H_j - H_i) \qquad (1)$$

$$= 1 - \frac{1}{2n^2\overline{H}} \sum_j \sum_i \text{Min} (H_j - H_i) \qquad (2)$$

$$= 1 + (1/\overline{H}) - (2/n^2\overline{H}) \quad (H_1 + H_2 + ...+ nH_n) \qquad (3)$$

$$\text{for} \quad H_1 \geq H_2 \geq .... \geq nH_n$$

where n : the number of cultivators
$\overline{H}$: the mean size of holding
H_i : the size of holding of the i^{th} cultivator
ij : identify cultivators i, j.

One way of looking at the Gini coefficient is in terms of the Lorenz curve depicted below.

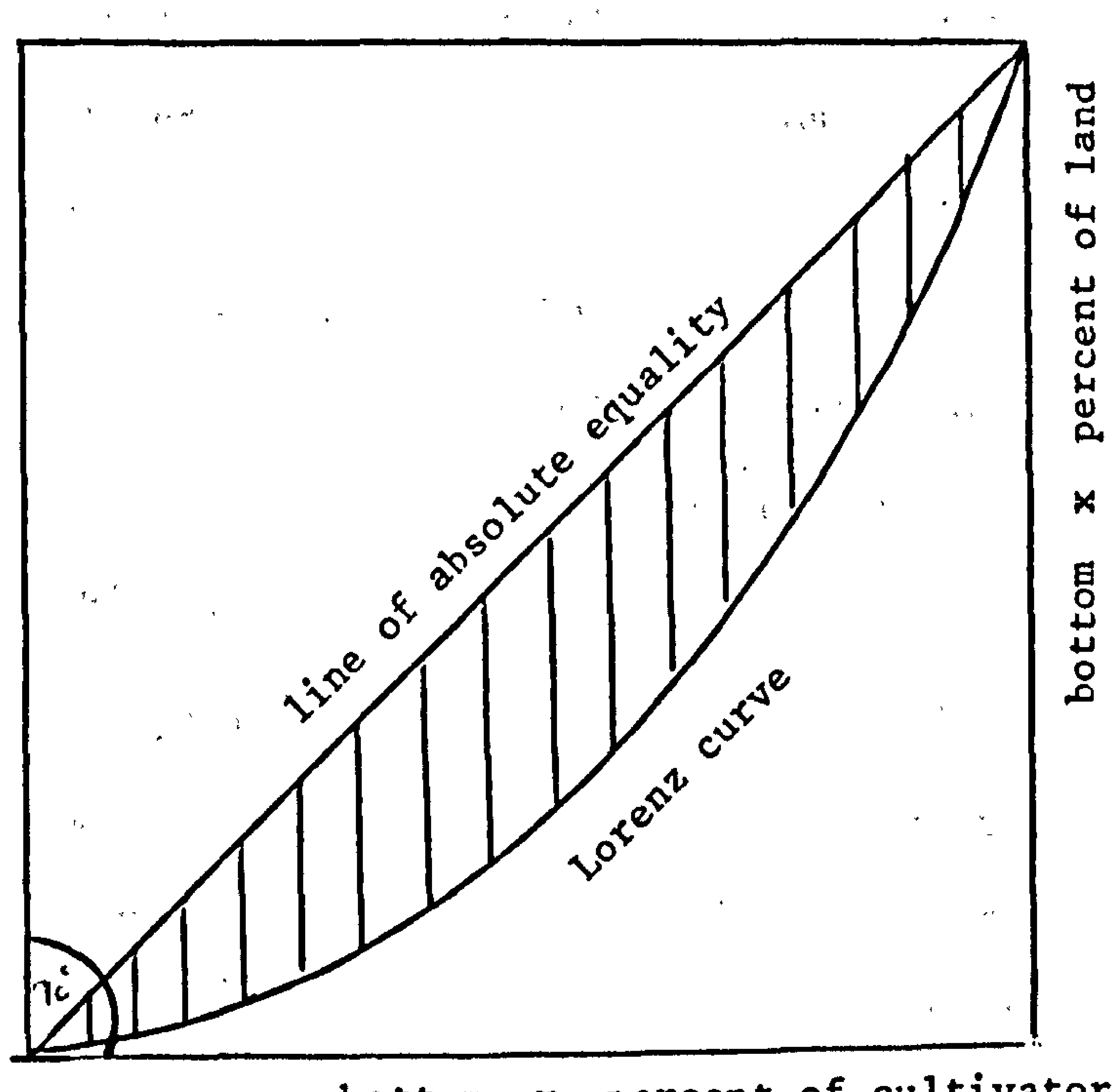


Fig. 3.1

In Figure 3.1 the percentage of the bottom x % of the cultivators in the total farming population of the village is represented on the horizontal line while the percentage of land cultivated by the bottom x % of the cultivators is given on the vertical line. If land is perfectly equally distributed the Lorenz curve is identical with the 45° line and the value of the Gini coefficient is 0. Any distribution away from perfect equality pushes the Lorenz curve towards the bottom right-hand corner of the box and thus increases the size of the shaded area which is measured by the value of the Gini coefficient.

Each of the expressions (1) - (3) for the Gini coefficient has its own interpretation. Thus, (1) suggests that if a cultivator with a smaller holding, in any pairwise comparison, feels inferior and if this feeling can be measured to be proportional to the difference in the size of holding between the two, then the Gini coefficient is the addition of all such feelings. The welfare function underlying the Gini-coefficient can be identified in expression (2). The welfare function is such that the level of welfare for any pair of cultivators is given by the minimum of the two cultivators. Finally, (3) suggests that the implicit welfare function underlying the Gini-coefficient is a rank order weighted sum of different person's size of holding. As such, it is sensitive not to the various sizes of holding but to the number of cultivators falling between the size-categories. This is a weakness of the measure. Another weakness is that it does not imply a strictly concave welfare function (which is a particularly desirable property when discussing social welfare - Atkinson (1970)).

With this discussion of the definition and the problems surrounding the Gini-coefficient, we are now ready to look at the value of the coefficient measuring the distribution of land among cultivators in our villages. These are given in Table 3.5. In the Table, two sets of values are given. The first row gives the values of Gini-coefficients for the distribution of land owned by the cultivators while the second row gives the values for operational holding. The values of the ratio of the two coefficients are given in the third row.

Table 3.5 Gini coefficients of land holding in the four villages

Village / Gini coefficient	Khunda	Jatli	Mehdiabad	Chak
Gini coefficient I (land owned)	0.64	0.49	0.63	0.43
Gini coefficient II (operational holdings)	0.48	0.47	0.59	0.42
Ratio of I & II	1.33	1.04	1.07	1.02

It must be remembered that our measures of inequality are likely to be underestimated since the holdings of non-cultivating landowners have been excluded from our calculation. Underestimation may also be due to the exclusion of the landless in the village.

The values of the Gini-coefficient given in the second row of the table allow a comparison of the distribution of operational holdings in the four villages. We can see straight away from the values that land is unequally distributed in all the villages. However, Mehdiabad stands out sharply against the other villages in that land is more unqually distributed in this village compared to the others. We saw earlier that in Mehdiabad most of the land is owned by the Syed family. The remaining land is cultivated by a large number of small farmers. It is interesting to note in Khunda that despite the presence of three or four big 'Maliks' who own most of the land in the village, the distribution of landholdings is no worse than in Jatli where the largest holdings are fewer and smaller in size. This is explained by our observation noted earlier that only one of the big 'Maliks'in Khunda self-cultivates his land. The others rent theirs out to a large number of small cultivators. The importance of the tenancy market in the redistribution may be seen clearly by considering the first row in Table 3.5 which gives the values of the Gini-coefficients of land owned in the four villages. In both Jatli and Chak the incidence of tenancy is low so that the values of the two Gini-coefficients are not very different. In Khunda and Medhdiabad, however, tenancies are widespread. Consequently the values of the Gini-coefficient I are higher than those of Gini-coefficient II. (The difference in the values would be even greater if we include non-cultivating landlords and landless labourers in the calculation of the Gini-coefficient I.) The third row in Table 3.5 gives the values of the ratio of Gini-coefficients I and II. This value is highest in Khunda which underlines the importance of the tenancy market in this village.

It is useful to compare our values of the Gini-coefficient for the four villages with those for Pakistan and Punjab reported by Naseem (1979). Using very aggregate data from the agricultural census, 1972, Naseem gives the values of Gini-coefficients I and II for Punjab to be 0.63 and 0.48 respectively. Thus, except in Mehdiabad , the distribution of operational holdings in our villages is not very different from Punjab as a whole. Further, the comparison of values of Gini-coefficient I in our villages with that of Punjab indicates that the pattern of land ownership in Khunda and Mehdiabad is more typical of the Punjab pattern as compared to the pattern in Jatli and Chak.

Concluding remarks

Our discussion of the land market indicates that land ownership in all four villages is concentrated amongst the large owners. However, transactions in the land market occur frequently in all the villages through the market for tenancies. These markets enable landless tenants to have access to land, on the one hand, and on the other, allow landowners with land in excess of their labour endowments to acquire labour. In this manner land markets are closely inter-linked with markets for labour.

The importance of tenancy in redistributing land raises a number of issues. One is the issue of the incidence of tenancy which requires a discussion of the determinants of tenancy and will be taken up in Chapter 5, Section 5.2. Another issue is this ; it may be argued that the redistribution of land through operations in the tenancy market enables the cultivation of excess land which would, otherwise, perhaps not be cultivated, or it may be cultivated inefficiently compared to cultivation by tenants (landowners may be reluctant to sell land for a number of reasons connected with the security of land as an asset and also because of the social status attached to land ownership). An alternative procedure would be to achieve redistribution through land reform whereby land is transferred to other cultivators giving them ownership rights in the land. We may compare the two methods of redsitributing land by determining whether tenants are as efficient as owner-cultivators in resource allocation on the farm. This will be the topic of our discussion in Chapter 5, Section 5.1.

Section 3.2 Tenancy contracts

In Chapter 2, Section 2.2 we discussed the theory of share-cropping tenancy. We stressed that the nature of the contract is important in determining the economic efficiency of different tenurial arrangements. Thus the Marshallian tradition that asserts tenurial inefficiency assumes that the decisions regarding resource allocation on the rented farm are made by the tenant alone. We then discussed theoretical models that suggest that with proper supervision, input stipulation and cost-sharing arrangements landowners can ensure that their share-cropping tenants allocate resources efficiently. In this section we shall present a general discussion of share-cropping arrangements on the basis of evidence collected in Khanewal. (Later, in Chapter 5, we shall give a general description of contracts in the four villages.) Our main objective will be to identify the factors contributing to the land-owner's bargaining strength that enables him to stipulate levels of inputs in the contracts. This involves a detailed discussion of the market for tenancies and the terms of the contract under which tenancies are held. We shall attempt to gauge the landowner's bargaining strength by observing the behaviour and responses of tenants regarding agricultural activity. We shall determine whether some of the landowner's bargaining power can be explained by his control over other input markets such as labour and capital and the degree of his influence in markets for agricultural output. A detailed discussion of the sharing arrangements will be presented.

Evidence on the terms and conditions governing share-cropping contracts was collected in a survey conducted in Khanewal subdivision of the Punjāb. We have already described the survey in detail in Section 1.2 of Chapter 1. For the purposes of this section it is important to remember that in our sample of 90 farmers, 54 were share-croppers chosen from ten villages to reflect the settlement schemes adopted in different areas within Khanewal subdivision.

Size of the plot

Share-croppers in our sample usually come from a traditional cultivator background. 28% of the sampled share-croppers reported owning some land before acquiring the current status of a landless share-cropper (we did not include owner-cum-tenants in our sample). The average size of plots, once owned, was 4 acres. 12% of the share-croppers reported having relatives who own land, while 30% have relatives who are also share-croppers.

The average size of holding of a tenant in our sample is 14.07 acres with a standard deviation of 7.98. The smallest tenant cultivator has 2 acres and the largest 50 acres. The 14 acre holding is also the modal plot in our sample. In Khanewal size of the plot is often measured in terms of bullock capacity rather than acreage. Thus a 14 acre plot corresponds to a pair of standard bullock capacity to plough for a crop season. Clearly, some adjustment is made due to differences in the quality of land.

We shall now present arguments to ascertain whether the 14 acre unit - if it were to be considered the equilibrium size of the share-cropped plot - could have resulted from a Cheungian process in which the landowner selects the number of plots,or the Marshallian,whereby the tenant is free to choose the amount of land he cultivates.

In the Marshallian framework a tenant increases income by increasing the size of holding. Bullock capacity is not a binding constraint on the tenant since his objective is extensive cultivation (see Section 2.2, Chapter 2), which may be achieved by spreading the existing endowments of labour and bullock power over a large land area. Our evidence that tenants usually own a pair of bullocks that can cultivate 14 acres in a season suggests, however, that the constraint of bullock capacity may be binding on the tenant. Thus the Marshallian reasoning is not a convincing explanation of the size of the plot in our sample.

Cheung's analysis suggests that given the share-proportion a landowner may extract more rent from the tenant by reducing the size of plot with the constraint that the tenant's income does not fall below what he could earn in the labour market (see Section 2.2, Chapter 2). Given that a standard pair of bullocks cultivate 12-14 acres of land, a reduction below this size is likely to result in excess capacity of bullocks (and of human labour because of the high correlation between the two in agriculture). Given the difficulties for cultivators of obtaining seasonal employment, this is likely to lower the tenant's income compared to what he could earn as a permanent labourer. On the other hand, a larger plot, given the share proportion, is likely to reduce the landowner's total income. It appears, therefore, that while the landowner has the bargaining power to determine the size of plot, he is constrained not only by the tenant's opportunity cost of foregone income à la Cheung, but also by bullock capacity. The latter constraint may become less important with increasing mechanization. A detailed discussion of the impact of mechanization on the tenurial contract will be presented in Chapter 5.

The market for tenancies

Clearly, the degree of a landowner's bargaining strength is likely to influence the nature of the tenurial contract regarding input stipulation and cost-sharing arrangements. It may be argued that this strength is greater if several small tenants bargain with a few large landowners who act as monopolists in the tenancy market. Alternatively, tenants are likely to have greater bargaining strength compared to landowners if land is rented in from several relatively small landowners. We shall examine this issue empirically.

Out of our 54 sampled share-croppers, 27 (50%) rent in land from one main landowner, 18 (33%) rent in land from at least two landowners, while only 9 (17%) rent in land from three landowners. It appears that share-croppers in Khanewal distinguish between three types of landowners on the basis of the size of holding and the amount of land rented from each. The main landowner usually owns a large amount of land (our sample average is 101.54 acres) and is the main source of share-cropped land. The second landowner is relatively small (sample average is 43.85 acres) and the third landowner is smaller still (sample average is 10.81 acres). Thus the second and third landowners are relatively less important sources of rented land.

Land owned by most landowners is in large contiguous units. The average number of fragments per farm being 1.42. There are a few exceptions to this pattern. At least one landowner's holding was divided into 9 fragments and another's into 6 fragments. 74% of the main landowners had all their land in the same village. We noted three landowners who owned land in other districts so that the average distance amongst the plots was over 50 miles. In most cases of fragmented holdings, where fragments of land were owned outside one village, the average distance between fragments was less than 4 miles.

Our evidence suggests that although some share-croppers rent in land from more than one landowner the main source of rented land is usually one big landowner. Land is rented in from other landowners only if it is contiguous with the land already rented in the village. Share-croppers reported that typically the main landowner has three other share-cropping tenants while the less important landowners have at least one other share-cropping tenant. All three categories of landowners have some land under self-cultivation and/or under fixed-rent tenancies. Most share-croppers thought that there was no difference in the quality of land they rented in and the land self-cultivated by the landowner and/or rented out by him on fixed-rent leases.

The overall picture that emerges suggests that typically the rental contract is negotiated in a situation where landless, traditional cultivators are confronted by fairly large landowners who have a reasonably good knowledge of cultivation practices given that they also self-cultivate land. Thus while stipulating inputs on share-cropped land, landowners or their representatives may expect an allocation of resources that is at least comparable to that of the other, allocatively efficient, tenurial arrangements.

The relative strength of share-croppers and landowners in the market for tenancies is likely to be influenced not only by the available opportunities in other markets (fixed-share tenancies or self-cultivation for landowners and wage employment for tenants) but also by the availability of other similar contracts in the market for share-cropping tenancies. All the share croppers we interviewed thought, without exception, that it would be quite easy for their landowners to get other share-croppers. On the other hand only 30(56%) of share-croppers thought they could rent land easily on share-cropping contracts from other landowners. Only 13 (24%) share-croppers thought that they could get land in the same or nearby villages (within a radius of 4 miles). Most of the difficulties of obtaining other contracts were reported to be on account of what we may describe as search costs. Negotiations for tenancy contracts are conducted, typically, at the beginning of the kharif season. In Khanewal the period between rabi (wheat) and kharif (cotton) seasons is quite brief. This results in high search costs of obtaining new contracts - particularly when some travelling is involved. The cost is usually perceived in terms of the impact on yields of late sowing of the kharif crop.

Our brief discussion of the market for share-cropping tenancies suggests that it is likely to be a seller's market. This implies that landowners are likely to have a relatively strong bargaining position compared to the share-cropping tenants. Therefore, it is reasonable to suppose that landowners can stipulate inputs to ensure efficient allocation by their share-croppers à la Cheung. We shall next discuss the inputs stipulated by the landowners and the cost-sharing arrangements contracted on share-cropped land.

Input stipulation and cost-sharing

In labour intensive agriculture input stipulation may be achieved by specifying the intensity of effort, i.e. labour effort per acre. The supervision costs of ensuring 'appropriate' labour effort per acre are likely to be quite high. Less costly alternatives may be the stipulation of mandays per crop or the number of household members working on the plot. Both these checks of labour effort are used by landowners. However, the most effective method and the least demanding in terms of supervision is to stipulate activities. Most agricultural activities in Khanewal are labour intensive. At the same time they reflect technical norms (e.g. the number of ploughings, irrigations and weedings per acre). The sequential nature of these activities also helps to reduce the cost of supervision for the landlord. In our discussion of the empirical evidence, input stipulation by the landowner will be interpreted as activity stipulation.

Restricting ourselves to wheat crop only, six major agricultural activities can be identified for our sampled farmers. These are : canal irrigation, tube-well irrigation, bullock ploughing, fertilizer application and seed application. The level of activity is determined by the number of times each activity is performed for the first four activities and quantities applied for the last two. We shall be concerned primarily with the share-cropper's response to our question regarding decision-making on agricultural activities. Whether the level of each activity (e.g. the number of ploughings and irrigations) of a share cropper is the same as that of cultivators under other tenurial arrangemnts is an interesting issue in itself and will be discussed in Chapter 6.

We argued earlier that when tenants are free to make decisions concerning resource allocation, we have a situation characterised by Marshallian inefficiency. In Table 3.6, column 2 illustrates this argument in terms of decisions regarding agricultural activities. More than 50% of the share-croppers in our sample reported that they were free to choose the level of activities, the exception being fertilizer application. We shall interpret column 3, which indicates joint decision making by the landowner and tenant to be the Cheungian input stipulation case since, given their strong bargaining position, landowners' 'suggestions' are likely to carry more weight in this decision-making process. Column 4, then, captures the response of the exceptionally 'frank' Cheungian tenant who admits to the landowner being the real decision-maker. On the basis of the response presented in Table 3.6 one might be led to conclude that input stipulation in the Cheungian sense is less frequently witnessed in Khanewal as compared to the Marshallian situation where the tenant has the freedom to decide.

In Table 3.7 we have presented tenants' response to our question regarding cost-sharing arrangements. Column 4 indicates that more than 50% of the share-croppers report that landowners share half of the costs (i.e. the same share-proportion as in output) of canal irrigation, tube-well irrigation and tractor ploughing. A vast majority of the tenants bear all the costs of bullock ploughing and seeds. It is interesting to note that despite joint decision-making regarding fertilizers most of the costs are borne by the share-croppers. Another notable feature is that where tractor cultivation is concerned, tenants pay, at most, 2/3rds of the cost - never full as in the case of some other inputs. Finally, only two share-croppers reported that their landowners pay all the costs of canal irrigation. This was done (we were told) to conceal share-cropping tenancy from the Government functionaries. The costs of canal irrigation are paid to the canal 'patwari' and records indicating cost-sharing of irrigation may be used as evidence of share-cropping tenancies and subjected to land reform regulations.

Table 3.6 Activity stipulation on share-cropped tenancies in Khanewal

(1) Activities	(2) Tenant's decision entirely	(3) Joint decision	(4) Landowner's decision entirely	(5) Number of share-croppers Total
1. Canal irrigation	39 (75)	12 (23)	1 (2)	52
2. Tube-well irrigation	23 (52)	21 (48)	-	44
3. Bullock ploughing	46 (92)	4 (8)	-	50
4. Tractor ploughing	31 (89)	4 (11)	-	35
5. Fertilizer application	18 (35)	32 (62)	2 (3)	52
6. Seed application	24 (56)	19 (44)	-	43

Figures in brackets are percentages

Table 3.7 Cost-sharing proportions on share-cropped tenancies in Khanewal

(1) Activities	(2) All Tenant	(3) 1/3 Landowner	(4) 1/2 Landowner	(5) All Landowner	(6) Number of share-croppers Total
1. Canal irrigation	4 (8)	1 (2)	45 (87)	2 (3)	52
2. Tube-well irrigation	1 (2)	1 (2)	42 (96)	-	44
3. Bullock ploughing	46 (92)	-	4 (8)	-	50
4. Tractor ploughing	-	16 (46)	19 (54)	-	35
5. Fertilizer application	51 (98)	-	1 (2)	-	52
6. Seed application	36 (84)	-	7 (16)	-	43

Figures in brackets are percentages

We argued in Chapter 2 that input stipulation and cost-sharing are alternative methods of achieving efficient resource allocation on share-cropped land. Considering columns 3 and 4 of Tables 3.6 and 3.7 respectively we may note that input stipulation/cost-sharing exists for four of the six major agricultural activities that we have identified for our sample of farmers for wheat crop. Thus except for bullock ploughing and seed application, the majority of the share-croppers in our sample conform to the'efficient' Cheungian assumptions regarding input stipulation and cost-sharing.

Next, we shall discuss the arrangements by which a landowner in Khanewal ensures that the tenants apply the stipulated inputs.

Contract enforcement

Input stipulation will work toward efficient allocation of resources if landowners can devise ways of ensuring that the share-cropping tenant uses the stipulated inputs. Similarly, cost-sharing may also influence resource allocation if the landowner can ensure that the share-cropper actually fulfills his part of the contract. To ensure that contracts are fulfilled landowners may have to supervise cultivation either themselves or through hired managers. In Table 3.8 we present the pattern of landowner supervision of share-cropped land.

Most effective supervision is achieved when the landowner visits the plot at least once a week. In several discussions with agricultural extension workers and landowners we learnt that a weekly visit was the norm for most 'progressive' landowners. The practice of a monthly visit is due to the tradition that sprang up in certain parts of Khanewal where landowners had to travel several miles to visit their tenanted land. The holding usually comprised of a number of large blocks at some distance from each other. This practice appears to be dying now because of both

Table 3.8 Landowner's supervision of rented-out plots in Khanewal

(Number of share-croppers)

At least one visit	Main landowner	2nd landowner	3rd landowner
Every week	37 (69)	14 (77)	5 (72)
Every month	4 (7)	1 (6)	1 (14)
Every crop season	6 (11)	1 (6)	-
Every year	7 (13)	2 (11)	1 (14)

Figures in brackets are percentages

Table 3.9 Duration of the lease of rented-out plots in Khanewal

(Number of years)

Duration of Lease	Main Landlord	2nd Landlord	3rd Landlord
Average duration of the lease	11.78	8.28	8.57
Minimum duration	1	1	1
Maximum duration	45	30	30

improvements in roads, public and private transport and division of property over time. Landowners residing in rural areas visit their tenanted plots at least once a week while those with urban business, professional or political interests visit once every crop season - usually at harvest time. We also learntthat absentee landowners may be defined to be those landowners who visit once a year to make their presence known. The supervision element in such visits is rather small.

From Table 3.8 it may be seen that 69% of the share-croppers report at least a weekly visit by the main landowner. The proportion of share-croppers reporting weekly visits by their 2nd and 3rd lanowners is even higher. This may be explained partly by the size-effect. The two less important landowners, on average, own smaller holdings and therefore can supervise land more closely. At the other extreme, the main landowner of at least 13% of the share-croppers in our sample are absentee landowners.

Apart from direct supervision involving a visit to the plot at least once every week there are other methods by which the landowner can enforce the contract. One such method is the control over the duration of the lease (Marshall (1950); Johnson (1950); Cheung (1969)).

In order to ensure the application of stipulated inputs it is not necessary to have a high turnover rate of share-croppers but to maintain the threat of eviction. Evidence from Khanewal suggests that the latter is the usual practice. In Table 3.9 it will be seen that the average duration of the lease is quite long (share-croppers reported the duration to be more than eight years for each landlord). However, the threat of eviction is felt quite strongly. 46% of the tenants in our sample thought that their landowner would find it quite easy to evict them while 60% of the tenants have experienced eviction during their lifetime. This threat and the fact that it is relatively easy for the landowners to find other tenants, together, ensure that share-croppers allocate the inputs stipulated in the contract.

Landowners may exercise control over the tenants also through the traditional structures of the rural society. The role of kinship in peasant behaviour has been analysed in a number of studies (Ahmed (1977), Alavi (1972), Barth (1980)). These studies suggest that peasants are concerned with the welfare of much larger units than just the immediate household (defined in terms of the number of people sharing the hearth). Thus, paternal relatives are considered members of the household even if they live separately. Large landowners often rent out land to brothers or paternal cousins who cultivate land separately. One reason why such contracts exist in Khanewal may be the nature of canal colony settlement schemes. Land in Khanewal was made arable by the provision of canal water and then auctioned off. The buyers were mainly non-cultivating landowners. At the same time migration was encouraged from northern and central districts of Punjab so that section of 'biratheries' settled down together in the newly-established villages in the canal colonies. The landowners owning large parcels of land rented them out in smaller units to tenants who were often related to each other (or came from the same 'biratheri'). In our sample 30% of the tenants reported that their cousins/uncles were also share-croppers who rented land from the same landowner.

Given the rapid rise in rural population and the abundance of tenants (as share-croppers or fixed-rent tenants) a landowner needs to have one fixed-rent tenant to define a standard of efficiency on his land.[1/] He can then ensure that his share-cropping tenants achieve that standard of efficiency either through input stipulation and/or cost-sharing. To enforce the contract he may combine direct supervision with the threat of eviction of a recalcitrant tenant and then let kinship do the rest for him. The efficient share-croppers will usually coax their inefficient relatives to work harder. A growing trend in Khanewal is to have different tenurial contracts within the same 'biratheri'. Thus a landowner may have a share-cropper on one parcel of land and a fixed-rent tenant on the other and the two may be related to each other.

Section 3.3 The credit market

We shall next present some details concerning the operation of rural credit markets in the four villages and in Khanewal.

Information on rural borrowing in Pakistan is difficult to obtain. The general problemsof obtaining quantitative information in a survey such as ours have already been mentioned in Chapter 1. We faced some of these problems when we sought information on borrowing by households. Loans are often rolled over from one crop season to

---

1/. Assuming that land is homogenous and the landowner can observe the input/output configuration on the fixed-rent tenancy.

another, different sources charge different interest rates and several types of loans (cash or kind) may be taken from various sources to meet different needs. This places great demand on the small cultivator's memory to recall all the relevant information, so that the reported answers should be considered as approximations to the actual quantities transacted. Another important reason is due to the social stigma attached to going into debt. This is particularly true for borrowing for consumption. The tendency, therefore, is to underreport the amount of loans taken.

In Pakistan there is a religious reason that tends to complicate matters further. The Islamic tradition considers the concept of interest rates to be unethical and, therefore, strictly forbids both the payment and charging of interest rates. There appears to be no prohibition on charging implicit interest rates through inflating profit margins - a trick often resorted to by loan-giving institutions throughout the history of Islamic nations (see Rodinson (1977)). In practice, of course, there is considerable borrowing and lending with both implicit as well as explicit interest rates being charged. However, few agents operating in the capital markets openly admit to either paying or charging interest rates. It is interesting to note, however, that this applies mainly to private money lending and not to Government loan-giving agencies.

To the extent, therefore, that loans are taken from non-Government resources, cultivators tend to under-report the amounts borrowed and fail to report interest rates paid. Given the difficulties of obtaining information on the amounts, we have restricted our main investigation to the qualitative variables only. Thus we shall discuss the credit markets in terms of the types of agents operating in the market and the use to which credit is put, in the four villages. Greater detail will be provided for our sample of farmers in Khanewal.

On the supply side of the rural credit markets we shall discuss the sources of credit. There are four broad categories of creditors. in our villages. An important source is friends and the 'biratheri'. We noted in Section3.2 the importance of 'biratheri' in the social structure of the village. An important function of the 'biratheri' is to provide interest-free loans to members. The second category consists of three sets of suppliers of rural credit. All three charge implicit rather than explicit interest rates. They are all involved in the exchange of commodities in the rural areas and are known as middlemen/arhtia/shopkeeper. The middleman, 'beopari', goes from village to village buying small amounts of agricultural produce from the growers and sells them to large dealers in market towns ('arhtias') either for a commission or a small profit. He extends small loans to the cultivators in exchange for a promise that the crop would be sold to him and not to any other dealer. The prices that he pays to the growers are usually not very different from those of other categories of middlemen. The implicit interest rate is charged in terms of the profit foregone by the cultivators by not participating directly in the commodity markets in the town. The main recipients of the loans extended by the 'beopari' are the small cultivators. The 'arhtia', on the other hand, deals in large quantities of crops and is usually based in a market town. He may, occasionally, charge explicit interest rates on the loans extended but mainly the interest rate is implicit and arises through the foregone profits that the tied growers could get by dealing directly with the wholesalers in urban centres. The 'arhtia' extends loans in both cash as well as in kind. The main recipients of loans are the large growers. The main source of consumption loans for the small cultivators is the village shopkeeper. The usual practice is not to lend money but to sell consumable items (such as flour, vegetables, oil, soap and cloth) on credit. The implicit interest rate that he charges is in terms of the higher prices paid for commodities purchased on credit.

The third category of suppliers of rural credit are landlords. Cultivators who are non-landowning tenants borrow from landlords.. Only exceptionally do landlords charge interest rates on loans, the exceptions being those landlords who are also 'arhtias'. Loans taken from landlords are used both for production as well as consumption[1/]. Traditionally consumption loans were important and were part of the patronage extended by the landlord to the tenant. With the introduction of 'green revolution' technology, production loans have assumed greater significance. Landlords extend loans to tenants to encourage them to use modern inputs. We shall discuss this arrangement in detail in Chapter 5.

Another category of suppliers of rural credit in the four villages are banks and co-operatives. Banks are both private as well as publicly owned. We shall refer to their rules of extending credit in the discussions that follow.

The evidence concerning the sources of credit in the four villages and in Khanewal is presented in Table 3.10. The main source of borrowing in the four villages are friends and relatives. The percentage of farmers borrowing from this source is over 80% in all villages except Mehdiabad where slightly fewer farmers borrow from this source. The next important source of credit in the villages is the middleman/arhtia/shopkeeper category. (The low figure in Chak is due to the lack of response of owner-cultivators to questions regarding credit sources.) Banks and

---

1/. It is hard to distinguish between the different uses to which a loan may be put. For example, a cultivator who borrows to purchase fertilizer frees an equivalent amount of his own resources for consumption so that it is hard to determine whether the loan is used to finance production or consumption.

co-operatives follow next in terms of importance. Except in Jatli, landlords extend credit to tenants but are usually the least frequently cited source of credit in the villages. In Khunda, the investigating team was told during casual conversations that landlords often extend loans to their tenants. However, no tenants reported having taken credit from landlords in response to the specific questions in the questionnaires.

On the demand side of the credit market, friends and relatives are the most important sources of credit for tenants and owner-cum-tenants, (to keep things simple we shall not distinguish between share-cropping tenants and fixed-rent tenants in this section). Banks and co-operatives, on the other hand, are important to owner-cultivators and owner-cum-tenants only. No tenants in any of the villages report borrowing from this source. This is probably due to the stringent requirements of collateral and other lending policies of these institutions. Except in Chak, owner-cum-tenants do not borrow from their landowners. This suggests that due to ownership of land this tenurial category does not depend on landowner's patrongage. There appears to be no clear pattern concerning borrowing from the category middleman/arhtia/shopkeeper. The only safe statement that we may make is that, typically, it is the small cultivators who borrow from this source.

In Khanewal the pattern of borrowing from different sources of credit changes considerably, compared to the four villages. The most frequently cited source of borrowing is the bank/co-op category. This is indicative of the effectiveness of the vast network of credit institutions in Khanewal. Branches of private commercial banks and the Agricultural Development Bank are supplemented by co-operative societies in facilitating the extension of loans to the growers. It may be noted in Table 3.10 that nearly twice as many owner-cultivators report using these facilities compared to tenants. For tenants both landowners and middlemen/arhtia/

Table 3.10 Sources of credit in the four villages and in Khanewal

(Percentages of cultivators)

	Relations & friends	Middleman/ ahrtia/ shopkeeper	Bank/co-op	Landowner
Khunda				
Owners	76	6	18	-
Owner-cum-tenants	100	-	-	-
Tenants	92	8	-	N/A
All	89	7	14	-
Jatli				
Owners	62	24	14	-
Owner-cum-tenants	67	18	15	-
Tenants	100	-	-	-
All	81	14	5	-
Mehdiabad				
Owners	50	21	29	-
Owner-cum-tenants	70	10	20	-
Tenants	70	15	-	15
All	63	16	14	7
Chak				
Owners	87	N/A	13	-
Owner-cum-tenants	67	10	19	4
Tenants	82	9	-	9
All	82	3	13	2
Khanewal				
Owners	5	5	90	-
Tenants	15	22	33	30
All	11	14	57	18

shopkeeper category are infrequently cited sources of credit partly due to the size effect; the mean holding of owner-cultivators is quite high in our sample which improves access to banks and co-operatives. The mean distance from the source of credit for owner-cultivators in our sample in Khanewal is 12 miles and for tenants 3.5 miles. This is reflective of the modal credit source for the two categories of cultivators. Owner-cultivators borrow mainly from banks with branches in important market centres while tenants borrow from relations and friends and middlemen/arhtia/shopkeeper categories that are located near the village.

The percentages of cultivators participating in the credit market in each of the villages and in Khanewal are presented in Table 3.11.

Table 3.11 Participation in credit markets in the four villages and in Khanewal

(Percentages)

	Owners	Owner-cum-Tenants	Tenants	All
Khunda	88	75	81	75
Jatli	50	65	100	53
Mehdiabad	90	80	74	79
Chak	28	47	46	33
Khanewal	83	-	59	68

In all the villages except Chak more than half the cultivators participate in the rural credit market. Participation is much higher in Khunda and Mehdiabad compared to the other two villages. We noted in the previous section that these two villages also have the most unequal distribution of land. We have also seen that the disbursement of credit is such that it is easier for large farmers to borrow. Greater percentage of farmers borrowing in Khunda and Mehdiabad may therefore be explained by the greater concentration of land amongst the large farmers. This view is further strengthened by the evidence on participation rates of owner-cultivators. These are very high for owners in Khunda and in Mehdiabad. Low participation in Chak may be explained partially in terms of the difficulty of access to Government lending institutions ; the nearest institutional source for credit being at a considerable distance from the village. In none of the villages tenants appear to be at any particular disadvantage regarding participation in the credit market. In Khanewal, as discussed earlier in Chapter 1, the sample of farmers was purposively selected in order to test hypotheses concerning economic comparisons between share-cropping tenancies and owner-cultivators. Therefore, we have no data on the owner-cum-tenant category. Participation rate in the rural credit market is quite high both for owner-cultivators as well as tenants.

Noting the need for caution in interpreting quantitative information regarding borrowing in the credit market that we mentioned earlier, we have presented the average amount borrowed per cultivator in the four villages in Table 3.12. It may be seen that amounts borrowed per cultivator are considerably larger in the irrigated villages compared to the 'barani' villages. This may be explained by the greater need to borrow for purchasing farm input in the canal irrigated areas.

As we shall see in Chapter 6, the use of modern inputs is more widespread in the canal irrigated villages. Within tenurial categories, the average amounts borrowed are highest for owner-cultivators in the 'barani' villages. In the canal irrigated villages, however, the average amount is highest for owner-cum-tenants. This is mainly due to borrowing for tractor purchase which suggests a tenurial pattern. Tractors are

Table 3.12 Average amounts of credit taken in the villages and in Khanewal

(Rs per cultivators)

	Khunda	Jatli	Mehdiabad	Chak	Khanewal
Owners	5600.63	3688.28	7580.56	3434.09	13054.48
Owner-cum-tenants	1858.33	2255.85	13550.00	8577.88	-
Tenants	1390.29	1666.67	5697.00	2040.00	1001.07
All	3000.73	3404.23	8026.82	4526.39	6826.88

used on own farms and are also rented out. In the 'barani' villages only owners engage in the market for tractor services. However, in the canal irrigated villages it is mainly owner-cum-tenants who engage in such markets. Cultivators in this tenurial category may have greater endowment of labour and other complementary inputs compared to owned land. These resources may be allocated partly on additional land rented in and partly in organising the market for tractor hiring. Amongst the two canal irrigated villages, average borrowing is lower in Chak for all tenurial categories. This may be explained by the difficulty of access to Government credit institutions noted earlier. In all the villages the average amount borrowed per tenant is lower compared to all other categories. This suggests that although tenants participate in the credit market, the difficulties due to the requirements of collateral imply lower amounts borrowed compared to other tenurial categories. In Khanewal the average amount borrowed by owner-cultivators is considerably higher than the average amount borrowed by the tenants. Explanations that take into account both the source of borrowing and the use to which loans are put will be presented by considering in detail the evidence on the credit market in Khanewal.

The difference between indebtedness and participation in the credit market may be seen by considering the data in Khanewal. In Table 3.12 we reported the amount borrowed per cultivator in the previous annual cropping season. In Table 3.13 below we present evidence on the percentage of cultivators and the amount outstanding, taking into account the loan taken in the previous year. This is our measure of indebtedness.

Table 3.13 Loans outstanding in Khanewal

(in Rupees)

	Percentage of farmers with outstanding loans	Mean loan outstanding of farmers who have taken loans
Owner-cultivators	52	8089.17
Tenants	43	221.96

There is not much difference between the tenurial categories in terms of the frequency of the incidence of indebtedness among the cultivators. However, owner-cultivators carry over 40 times as much debt as tenants into the next cropping year.

We shall next present in Table 3.14 the most frequently cited use of loans taken by cultivators in the four villages and in Khanewal. Here, again, we shall discuss use in terms of four categories. The first is credit taken for food consumption. As discussed earlier the most common source for such borrowing is the middleman/arhtia/shopkeeper category and the most frequent borrowers are small owner-cultivators. Tenants are the least frequent borrowers for consumption. This may be explained partly by the fact that tenants get gifts from landowners. Such gifts are considered to be part of the patronage extended by the landowner and, as such, is not considered borrowing. Typically, it is the small owner-cultivator who borrows for consumption. We noted that in the 'barani' villages, at least, borrowing for food consumption is overwhelmingly the most frequently cited reason for borrowing. The second category represents the ceremonial need for borrowing. In both 'barani' villages it appears to be important. Surprisingly, amongst the tenants, the incidence of borrowing for this reason is the highest. This does not imply that tenants spend more than other cultivators on such ceremonies. It may suggest either that owners and owner-cum-tenants are better prepared for such contingencies as compared to tenants or that they may prefer to raise the necessary cash requirement either through renting out land or selling land than go into debt. A tenant, on the other hand, does not have recourse to the latter. It is possible, also, that because of greater mobility and insecurity of tenure tenants may be less well-prepared to meet such contingencies.

The next two categories represent demand for production loans. Information concerning borrowing for the purchase of livestock is presented for the canal irrigated villages only. This is not because this reason for borrowing is unimportant in the two 'barani' villages. On the contrary, these two villages belong to an area that is famous throughout the country for the sturdy 'dhani' breed of bullocks that is indigenous to the region. Throughout the year special weekly markets are organised in important market towns in the region for exhibition and exchange of 'dhani' bullocks. Cultivators in our two 'barani' villages participate in these markets regularly. It is quite likely, therefore, that some borrowing takes place to finance this market. Due to lack of foresight explicit questions were not asked in the questionnaire concerning the operation of bullock markets. In both canal irrigated villages, where questions were asked, it turns out that purchasing livestock is the most frequently cited reason for borrowing in Mehdiabad and the second most frequently cited reason in Chak. This requires further discussion.

A point that will be taken up in Chapters 4 and 5 is that markets for services of bullocks are virtually non-existent in any of the villages (or in Khanewal). We shall argue in Chapter 5 that the absence of bullock markets results in cultivators' adjusting their size of holding to endowments of bullock services. Once the optimal size of holding has been determined the cultivator is committed to it for the entire annual crop season. If, during the crop season, his bullocks fall ill or die or, due to changes in weather, he wishes to alter cultivation practices (so that greater use of bullock services is required) the cultivator has to purchase a new bullock. The amount involved is often quite large (the price of a bullock in the area is in the region of Rs 4000). The cultivator, therefore, has to borrow to finance the purchase.

The least frequently cited (less than 20% of farmers) reason for borrowing in all the villages is the purchase of farm inputs 1/. Tenants in neither Jatli nor Mehdiabad borrow to purchase inputs. This does not necessarily imply that tenants do not use new inputs (as we shall see in Chapter 6) but that they may use sources of credit, other than borrowing in the rural credit market, for financing the purchase of new inputs. (In Chapter 7 we shall argue that remittances from migrant household members may be an important alternative source for the purchase of new inputs.) In Mehdiabad, landowners share costs of new inputs with their tenants (see Chapter 5) to encourage input use. A common practice in the village is to pay the tenant's share of costs while purchasing inputs at the beginning of the cropping season and then to deduct the cost from the tenant's share in the harvest.

Borrowing for the purchase of inputs may be further disaggregated into borrowing for specific inputs. This has been done in Table 3.15. The main inputs purchased are seeds, fertilizers, and services of tractors.

1/. Here we are referring to inputs such as the new H.Y.V. seeds and chemical fertilizer.

Table 3.14 Use of credit in the four villages and in Khanewal

(Percentage of cultivators)

	Food consumption	Marriage/ death	Purchase of livestock	Purchase of farm inputs
Khunda				
Owners	70	30	N/A	-
Owner-cum-tenants	80	20	-	13
Tenants	51	49	N/A	19
All	56	43	N/A	15
Jatli				
Owners	54	45	N/A	14
Owner-cum-tenants	62	39	N/A	8
Tenants	33	67	N/A	-
All	54	45	N/A	13
Mehdiabad				
Owners	21	21	7	29
Owner-cum-tenants	-	10	50	17
Tenants	14	19	48	-
All	13	18	36	12
Chak				
Owners	83	5	7	13
Owner-cum-tenants	67	-	10	6
Tenants	55	9	27	17
All	77	4	11	11
Khanewal				
Owners	6	3	N/A	49
Tenants	31	69	N/A	53
All	21	43	N/A	51

In Mehdiabad loans are taken also to hire services of tractors and for purchasing pesticides.

In Khanewal borrowing for direct consumption of food is the least frequently cited of all the reasons for borrowing. However, this should be accepted with caution since the average size of owner-cultivators is quite high in our sample. When we consider tenants alone, marriage/death category is the most frequently cited reason for borrowing. Production loans are taken most frequently for the purchase of fertilizer both by owner-cultivators as well as share-croppers. This is explained by the fact that loans extended by banks/co-ops and 'ahrtias' are usually kind loans. The latter are also commission agents to manufacturers of fertilizers. A number of 'arhtias' informed us that they insist on giving kind loans to the cultivators since that encourages the use of the latest varieties of fertilizers suited to the soils of the region. This increases cultivators' yields and consequently the revenues of 'arhtias'. The other frequently cited reasons for borrowing by the large cultivators in our sample are the installation of tube-wells and the purchase of tractors and plant protection services.

The most frequently cited interest rates paid by cultivators in Khanewal on loans taken from banks/co-ops category range between 10% and 14%. 29% of the borrowers reported that usually rendering labour services on the farms of relatives and friends is a condition for borrowing from them. Thus implicit interest may exist not only in terms of profit margins as discussed earlier but also in terms of labour services.

An indicator of the ease with which the small cultivator can borrow is the facility to roll over loans from one cropping season to another. This may help in reducing the risk of borrowing since in times of harvest the pressure to pay back the loan is reduced and thus bankruptcies are avoided. For our sample in Khanewal, 37% of the interviewed cultivators

Table 3.15 Allocation of production loans to specific uses in the four villages

(Percentage of cultivators)

	Khunda	Jatli	Mehdiabad	Chak
Credit taken for seed				
Owners	0	0	33	10
Owner-cum-tenants	0	0	0	11
Tenants	20	0	0	33
All	17	0	8	14
Credit taken for fertilizer				
Owners	0	12	29	9
Owner-cum-tenants	0	8	8	0
Tenants	0	0	-	25
All	0	11	9	7
Credit taken for hiring tractors				
Owners	0	9	0	11
Owner-cum-tenants	0	0	0	0
Tenants	5	0	0	12
All	3	7	0	11

reported that their creditors allowed them to roll over loans.

It was discussed earlier in this section that tenants may be at a disadvantage compared to other cultivators in borrowing from banks/co-ops since those institutions require land as a collateral. One way to overcome this disadvantage is for the landowner to agree to be a guarantor to the loan-giving institution. However, at times of conflicting interests between landowner and share-cropper (in terms of resource allocation on the rented plot), the former may refuse to underwrite the loan and thus may make it difficult for the tenant to borrow from this source of credit. In our sample of farmers in Khanewal, 24% of the tenants reported that their landowners usually agree to underwrite loans. However, tenants borrowing from the middleman/arhtia/shopkeeper category reported that landowners' refusal to underwrite did not affect their ability to borrow since the ability to borrow from this source of credit is dependent mainly on the value of crops produced on the farm.

Concluding remarks

In our discussion of the sources of rural credit we attempted to establish that landowners are an important source of credit for the tenants. There is little evidence that they earn interest on loans given to tenants. Instead, the provision of loans appears to be a part of the patronage traditionally extended by the landowners. The evidence also indicates that landowners give loans to encourage tenants to use new inputs. Thus landowners in our villages and in Khanewal appear to act somewhat differently from Bhaduri's landlords (1971) for whom incomes earned from 'usu ry' are important and who discourage productive use of loans.

The most important source of borrowing for cultivators is the 'biratheri'. However, the 'biratheri' extends loans mainly for non-productive needs. One cannot describe this source as an exploiting monopoly in the supply of credit since interest rates are usually not charged. Banks and co-operatives are an important source of credit mainly for production loans and primarily for the large farmers. Loans are usually earmarked for specific inputs and, therefore, contribute in raising yields as well as in changing the cropping pattern. (In Khanewal 88% of the farmers reported that their cropping patterns had changed as a result of borrowing from this source.)

For most tenants, middleman/arhtia/shopkeeper category is the most important source of production loans. As we have argued, this category operates through the commodity market. There is an incentive for them to allocate their loanable funds to the most efficient cultivators, since their revenues are linked to the crop output delivered to them. Thus their operations are likely to influence yields on the farm.

On the basis of the evidence that we have presented in this section, rural credit markets appear to be linked to rural markets for crop output because the creditor and the purchaser of crop output is usually the same agent. The total profits of the agent are determined by the joint activity in the two markets. Such linkages rarely exist between the land and credit markets. Occasionally, tenants borrow from landowners but that is not directly related to landowners' income which arise mainly in terms of their share in crop output. In very rare cases landowner, creditor and the purchaser of output is the same agent (an occasional 'arhtia'). In such cases the inter-linkages between the three markets are strong.

The collateral requirement of borrowing from banks/co-operatives suggests another type of linkage between land and credit markets. Tenants may borrow from these institutions only if the landowners agree to be guarantors of loans. In this indirect manner the landowner may acquire control over both the land as well as the credit market. This joint control of the two markets may be used by the landowner to frustrate land reform regulations that attempt to give greater security of tenure to the tenant (see R. Herring (1979) for a detailed discussion of the issues involved).

The two important types of market linkages that we have suggested in this section are linkages between credit and output markets and between credit and land markets. One consequence of such linkages may be that the controlling agent, e.g. the 'arhtia' or the landowner, may exploit the linkages to his advantage as a monopolist controlling the two markets in which the small owner-cultivator or the tenant operates. Examples of landowners acting as exploiting monopolists in land and credit markets were noted particularly in Khunda and Mehdiabad where land is very unequally distributed. In a detailed study of the history of tenant-landlord litigation in Khunda, Nigar Ahmed (1980) has documented many cases in which big landlords were able to frustrate land reform regulations regarding tenants' security of tenure because of their control over both land and credit markets. Many instances were also reported in the villages where growers claimed that they were paid lower prices for their produce and charged higher prices for inputs sold by 'arhtias'.

But linkages in markets also work towards improving the overall productivity of cultivators. Thus 'arhtias' may encourage small farmers to grow new high yield variety strains of crops by assuring sales outlets. Similarly, landowners' better access to credit institutions may also result in the use of new inputs by the tenants. This view of linkages is stengthened when we consider that for efficient farming trust and co-operation between landowners and tenants on the one hand and 'arhtias' and growers on the other are very important. Thus market linkages are often likely to result in efficient cultivation.

Section 3.4 The labour market

Implicit in our discussion of the tenancy market presented in Section 3.2 was a description of the operation of the rural labour market. We argued in Section 1 that tenancy may result when adjustments are made in the relative factor endowments of landowners (who have an excess of land given labour) and tenants (who have an excess of labour given land). This argument will be taken up again in great detail in Chapter 5.

It is likely that in certain agricultural areas, the equilibrium size of the plot (note our discussion of Section 3.2) is too small to generate sufficient income for the share-cropping tenants to meet the food requirements of the family. Tenants may then hire out their labour services in the labour market during certain parts of the year. Evidence from Khunda and Mehdiabad (Table 3.16) suggests that landowners are an important source of employment for share-croppers. Owner-cum-share-croppers report working for their landowners less frequently but the incidence level remains quite high. This evidence suggests that there may be important linkages between the land and labour markets in a more direct sense than that suggested by operations in the tenancy market. With a change in technology (particularly with the introduction of tractors along with improvements in crop yields) landowners may prefer to cultivate land themselves rather than share-crop it. However, mechanization affects only ploughing. Other important farm activities such as sowing and harvesting remain labour intensive (see Binswanger (1977) and the detailed discussion in Chapters 5 and 7). A device for ensuring appropriate supply of labour at peak periods by self-cultivating landowners may be to provide small plots to labourers on share-cropping contracts. Thus,

Table 3.16 Tenants reporting employment on landowners' farm

(percentage of tenurial category)

Tenurial category	Khunda	Mehdiabad
Sharecroppers	79	88
Owner-cum-sharecroppers	26	50

Table 3.17 Tenants employed by landowners who do not receive wages in cash or kind in Khunda

Tenurial category	Percentages of employed tenants
Sharecroppers	8
Owner-cum-sharecroppers	-

Table 3.18 Employers of members of share-cropper households in Khanewal

(Percentages)

Employers	1st member	2nd member	3rd member
Landlord	18	7	7
Family farm	36	50	40
Arhtia	36	7	-
Other non-cultivators	9	29	47

For the ranking of members see text on p. 113.

with the introduction of new technology, the role of the tenancy market may change in the sense that open operation in the labour market may become the dominant feature of tenancy contracts. (These arguments will be taken up in considerable detail in Chapter 5.) Evidence presented in Table 3.17 suggests that at least in one of the villages, Khunda, employment on the landowner's farm may be part of the share-cropping contract so that no explicit payments are made for hiring share-cropper's labour on the landowner's farm.

Further evidence suggesting linkages between land and labour markets may be seen in Table 3.18 where evidence is presented from Khanewal. In our interviews during the field survey we asked questions about the employment of household members other than the head of household. It appears that after the family farm the second most important employer of members of the tenant household is the landowner (1st, 2nd and 3rd categories of household members reflect the ranking in terms of their importance as earners for the family as indicated by the head of the household during interviews). It is interesting to note that the 'arhtia' is an important source of employment in Khanewal. In the absence of appropriate empirical evidence we can only speculate on the reasons for this. We were given the impression in Khanewal that 'arhtias' are an important class of entrepreneurs in small agricultural towns. They invest profits earned in agricultural commodity exchange in commercial and small-scale industrial enterprises which then generate employment opportunities. Household members of cultivators who have been dealing with the 'arhtia' for a long time in commodity exchange, may get preference in employment. This arrangement, therefore, is suggestive of an important linkage between labour and the agricultural commodity markets.

Finally, the evidence on employment created on different farm size categories (these will be defined rigorously in Chapter 4) is presented in Table 3.19. The biggest employers of permanently hired labour are the large cultivators in three of the villages where data are available (Table 3.19 a) while small cultivators appear to rely mainly on family labour.

The crop-wise employment pattern of seasonal labour in the four villages is presented in Tables 3.19 b - e. The evidence suggests that the incidence of seasonal employment is high for wheat/groundnuts in the 'barani' villages, wheat/cotton in Mehdiabad (although sugarcane is also important) and wheat/sugarcane in Chak.

Large farmers appear to be the most important source of employment for seasonal labour as well. It is interesting to note that in the irrigated villages, employment of casual labour is higher by the large cultivators compared to other size categories.

Seasonal labour in Khunda is used mainly for wheat harvesting and peanut picking . Peanut crop was introduced in the village (as well as in Jatli) five years ago and has resulted in high demand for seasonal labour. Wages are paid both in cash and in kind. Meals and tea are provided as well. For wheat harvesting the wage rate is 1/10th of wheat harvested while for peanuts it varies between Rs 0.50 and Rs 0.75 per kilo. It appears that wages for wheat crop have doubled over the last 5 years when they were 1/20th of the wheat harvested. Most of the seasonal labour in the village comes from outside the village. Seasonal labourers who reside in the village are paid the same wages as those hired from outside.

Evidence from Mehdiabad indicates that most of the casual labour is hired from amongst the residents of the village. During the wheat harvest two major activities are reported for which labour is hired. One is threshing and the other is winnowing. The rate for threshing is 1/10th of the produce and has increased in the last 5 years by nearly

Table 3.19 a

Percentage of farms using permanent farm labour

	Khunda	Jatli	Mehdiabad	Chak
Small	0	1.6	14.3	0
Medium	0	0	26.0	16.7
Large	20.0	-	90.0	50.0

Table 3.19 b

Percentage of farms using seasonal labour in Khunda by different crops

	Wheat	Groundnuts
Small	0	9.1
Medium	0	31.3
Large	6.0	53.4

Table 3.19 c

Percentage of farms using seasonal labour in Jatli by different crops

	Wheat	Groundnuts	Bajra
Small	53.0	56.5	6.1
Medium	70.6	70.6	11.8
Large	80.0	61.0	20.0

Table 3.19 d

Percentage of farms using seasonal labour in Mehdiabad by different crops

	Wheat	Sugarcane	Maize	Cotton
Small	0	16.7	0	28.6
Medium	60.0	50.0	0	20.0
Large	63.0	54.0	60.0	71.4

Table 3.19 e

Percentage of farms using seasonal labour in Chak by different crops

	Wheat	Sugarcane	Maize
Small	10.0	33.3	0
Medium	12.5	25.0	0
Large	53.0	64.0	6.0

25%. For winnowing the wage rate is 1/20th of the produce. Sugar-cane cutting is paid by the day. The rate is Rs 10/- per day while 'gur' (unrefined sugar) making is paid at the rate of 1/20th of the produce. Female labour is used mainly for cotton picking. The wage rate is 1/20th of the produce.

Concluding remarks

Our evidence indicates that labour markets are active in all four villages and in Khanewal. Casual employment is widespread on all categories of farms. An important employer of tenant household's labour is the self-cultivating landowner. It is interesting to note that real wages for casual employment in the villages have been increasing in the last five years. An important new trend is the increased use of permanently hired farm labour. This may be explained as a consequence of mechanization which lowers the incidence of tenancy.

In this chapter we have presented a discussion of the working of rural factor markets in the villages and have pointed out some important linkages. This will provide a rich background for our formal analyses of production, tenancy, technological innovation and migration which will be presented in Chapters 4-7.

CHAPTER 4

The Relationship between Farm Size and Productivity

Section 4.0 Introduction

The analysis of production must lie at the core of an attempt to explain the economics of the village farming community. The economics of crop production in a village is complicated,being concerned with, among others, issues such as the optimal size of farm, tenancy, adoption of modern technology and migration. We noted in Chapter 2 that these issues are inter-related. To simplify matters we shall treat each of the issues separately. In this chapter we shall concentrate on the relationship between the size of farm and productivity.

The relationship between farm size and productivity is analytically interesting for many reasons. An analysis of the relationship indicates the special features that enable the efficient size-category of farms to use inputs more intensively than others. These features may be inherent to specific farms and non-marketable such as the quality of soil and farm supervision. Other reasons may arise due to imperfections in rural factor markets that enable some farm categories to have easier access to inputs compared to others. The organization of farms (i.e. whether farms use family labour or hired labour) may also be important in determining differences in the use of inputs. Thus the analysis of the size-productivity relationship helps us to understand the working of rural factor markets.

The empirical investigation of the nature of the relationship between farm size and productivity is important in determining public policy towards agriculture. Land reforms are a popular component of agricultural policy in many developing countries. The stated objectives of land reform are to make land less unequally distributed and to increase agricultural output. It is implicit in the twin objectives that small farms are more productive than large farms. The empirical analysis presented in this chapter will attempt to determine the validity of this assumption. Another aim will be to verify the magnitude of the difference in productivity across farm size.

Often the objective of agrarian policy is to intervene indirectly through fiscal means mainly by the provision of input subsidies. Thus an understanding of the working of input markets is invaluable in designing an efficient policy. It is hoped that our empirical investigation of the size-productivity relationship in the four villages of Punjab will clarify some of the issues involved.

The discussion of the size-productivity relationship is primarily concerned with the issue of efficiency. Therefore, a theoretical discussion of the different measures of efficiency may be necessary to clarify the concepts. The discussion will enable us to compare the usefulness of different measures such as ratios of output per unit of an input, or output per unit of cost. More comprehensive measures of efficiency that require the estimation of production functions, enable us to distinguish between technical and allocative efficiency and to evaluate the practical relevance of these two concepts. In Section 4.1 of this chapter we shall present a brief discussion of some measures of efficiency.

The empirical analysis of the size-productivity relationship presented in this chapter relies on the concept of a production function. In Section 4.2.0 we shall briefly introduce the notion of a production function, postponing the discussion of the specification of a production function and the theoretical problems of estimating using the ordinary least squares procedure to Section 4.2.3. The variables to be explained, i.e. the value of output in each village, are explained in Section 4.2.1. The important crops that constitute the value of total output on the farm will be discussed. The explanatory variables, farm inputs, are defined in Section 4.2.2. We shall discuss some of the problems of measurement and aggregation and then present a detailed account of the working of factor markets. The dualistic nature of some of the factor markets will be explained. Considering the labour market, we shall present the theoretical arguments that distinguish between family and hired labour. (The theoretical discussion will be presented here in order to refine some of the arguments already given in Chapter 2.) Some explanations will be offered for the non-existence of bullock markets in our villages. The importance of access to capital markets for using inputs such as high yield variety seeds and fertilizers will be discussed. In Section 4.2.3 we shall take up the issues left over from Section 4.2.0. We shall specify the production function that we shall use and the functional form that we shall estimate. The theoretical problems arising from the underlying simultaneity in the decision-making of farmers regarding inputs and outputs will be analysed. We shall argue that the parameters that we obtain by using our estimation procedure are consistent and unbiased.

Empirical results and their interpretations are provided in Section 4.3. In Section 4.3.1 we present the empirical evidence for the four villages using a production function in which land is the only input. This corresponds to the criterion of output per acre. We distinguish between technical efficiency and the intensity of land use. Using covariance analysis we shall rank villages according to both measures of efficiency. A 'test' of the functional form used in this section will be provided by considering the goodness of fit using different functional forms for one of the villages. Interpretations and explanations for the results will be offered in Section 4.3.2. The three hypotheses suggested in Chapter 2 as explanations for the relationship in the Indian context will be examined carefully in the light of evidence from our villages. The importance of intensity of cultivation will be analysed. The role of frag mentation and the hypotheses regarding the influence of family labour on the size-productivity relationship will be examined. The relationship will be estimated for owner-cultivator farms only to isolate the influence of tenancy on the relationship. Finally, the relationship will be estimated for small farms only in each village to suggest that, as a group, small farms use land more intensively compared to other farms. Cross-village comparisons will be made and explanations offered for the differences in the intensity of land use.

In Section 4.4.1 a production function with three inputs, viz. land, value of seeds and fertilizers, and the value of draught power, will be estimated for each village and for each size-category in a village. This will enable us to comment on returns to scale in each village and to comment on hypotheses regarding market imperfections that determine the difference in access to inputs and therefore the intensity of use. We shall also discuss the importance of uncertainty in resource allocation on the basis of the evidence in this section. Our discussion, here, will be a preliminary examination of evidence on input use. A detailed analysis of the direct evidence on the use of inputs associated with the 'green revolution' technology will be presented in Chapter 6.

Section 4.1 Measures of efficiency

A comprehensive measure of economic efficiency was suggested by Farrell (1957). It requires the estimation of a production isoquant that indicates the efficient combinations of inputs to produce a unit of output. The isoquant is estimated from the input combinations of a sample of observations with each observation representing an efficient firm.

It is the isoquant of the hypothetical, efficient production unit which is used as the standard for measuring the efficiency of the units in the sample. This method distinguishes between technical and price efficiency. For the two input case, it may be illustrated in the diagram below.

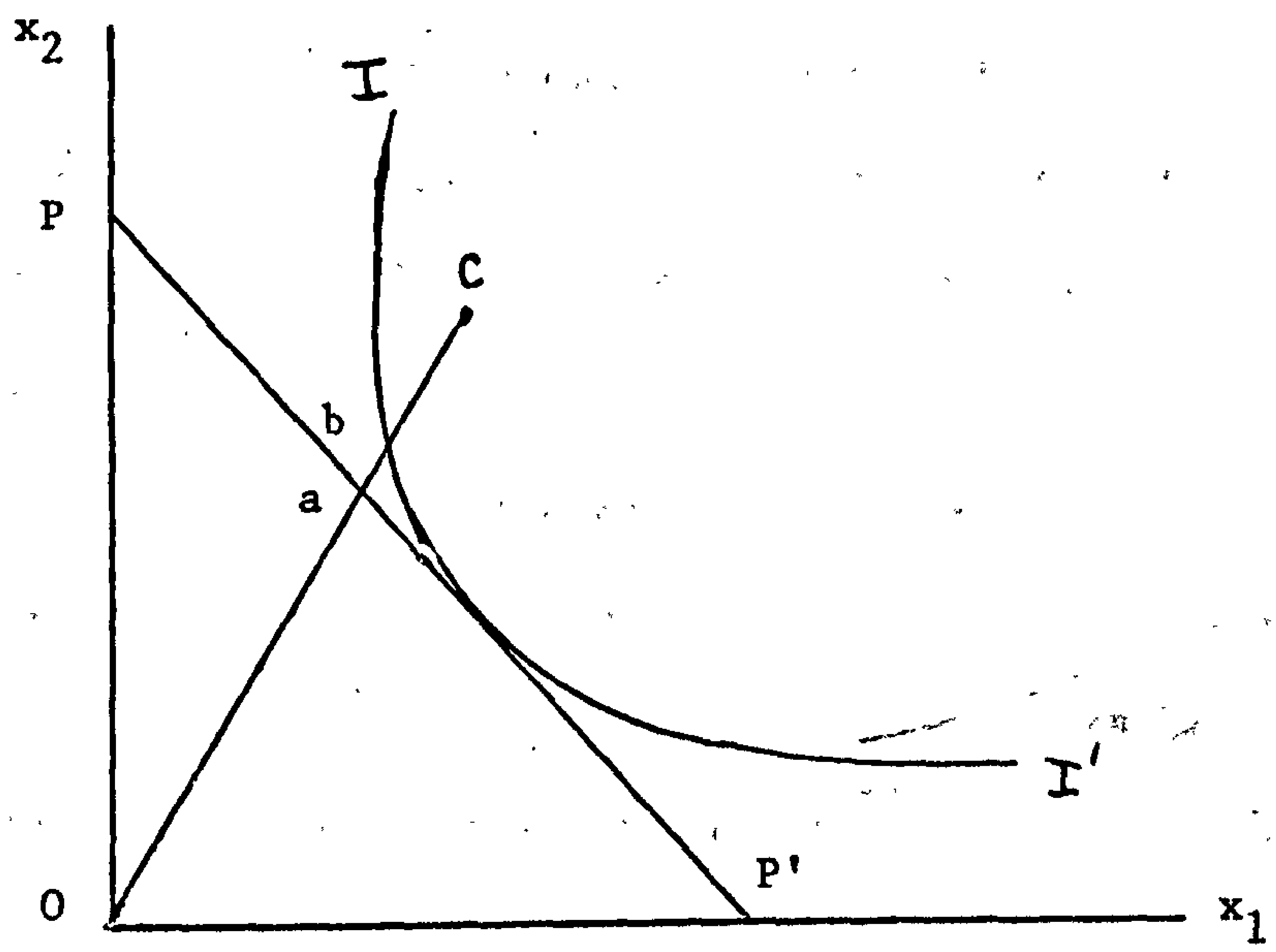


Figure 4.1

In the diagram, II' is the estimated, efficient, isoquant for the hypothetical production unit. For a unit that yields the input combination C, for a given output, technical efficiency, TE $= \frac{Ob}{OC}$ while price efficiency is, PE $= \frac{Oa}{Ob}$. Economic efficiency (EE) is the multiple of the two ratios, i.e. EE $= \frac{Oa}{OC} = \frac{Ob}{OC} \times \frac{Oa}{Ob}$.

H. Leibenstein (1966) has argued that empirical evidence from the U.S. and several other European countries suggests that allocative efficiency is not a very important component of the overall economic inefficiency. He discusses a number of studies that show that the welfare loss of monopoly and restrictive trade practices is rather small and ranges between 1 and 0.01% less than the possible revenues of efficient allocation. As opposed to this, evidence is presented to indicate that improvement in technical efficiency, by improving managerial practices, can lower costs by up to 30% of the existing costs.

Seitz (1970) has extended the theoretical concept of economic efficiency by introducing the notion of scale efficiency (SE) . He argues that economic efficiency may be defined separately for production units operating at different scales. The product, EE x SE, then gives an over all measure of efficiency. This measure enables us to identify the optimal scale of operations from the point of view of minimum cost for the industry as a whole.

Clearly, the theory of economic efficiency is fairly advanced and precise measures of different aspects of economic efficiency have been specified. In practice, however, data requirements of these measures are quite stringent. As a result, in the agricultural sector, most discussions of economic efficiency have been conducted using the traditional measures. The most commonly used measure is output per acre of land.

The importance of land in the production process stems in part from the belief that land ownership determines access to other inputs and thus influences productivity. Further, in economies with land scarcity, public policy discussion is often dominated by considerations of reforms that seek to rearrange patterns of land ownership. It is argued that large holdings are inefficient compared to small holdings. In our review of literature in Chapter 2 we discussed some of the studies that give empirical evidence that suggests the existence of an inverse relationship between size and productivity. In the policy conclusions of these studies it is argued that land reforms will not only bring about a more equal distribution of land but will increase the efficiency of agriculture in terms of output per acre.

Evidence on the relationship between size and productivity has been interpreted in another way. If small holdings are more efficient than large holdings, public policy that encourages co-operative farming should be abandoned since it results in consolidating the unit of operation and thus causes inefficiences.

It may be argued that neither of the two implications mentioned above are tenable since output per acre is not a meaningful measure of efficiency in a changing agricultural setting. For example, cultivation practices are influenced by the 'green revolution' technology inputs. Thus, the availability of land may no longer be as binding a constraint as it is under more traditional methods of cultivation. 'Green revolution' technology requires greater cash outlays on new inputs (such as high yield variety seeds and fertilizers) as well as on fixed inputs (such as tube-wells and irrigation ditches). The availability of new inputs enables variations in the intensity of cultivation. In this sense, with the introduction of new technology land becomes a less binding constraint. This implies that a more comprehensive efficiency measure such as the ratio of present net value of agricultural inputs to the value of output may be needed. This can be calculated by imputing the price of the services of land and adding this to the expenditure on other inputs. However, imputing the price of services of land is riddled with pitfalls of the type faced in capital theory. In pricing the services of land, allowances have to be made for quality; otherwise, the imputed price is too aggregated a measure of land input.

An alternative measure of efficiency used is the cost-output ratio (cost is measured in terms of total expenditure on variable inputs). Here a problem arises on account of imputing the value of bullock services. Unlike other inputs, there are no markets for services of bullock labour in many regions of Pakistan. (In Section 4.2.2 we shall discuss, in detail, the reasons for the absence of bullock markets in our villages.)

Besides, this measure of efficiency ignores land completely. This is unsatisfactory given that even in the technologically most sophisticated agriculture, land continues to be an important input.

From the above discussion it is clear that while output per acre as a measure of efficiency is relevant, it is far from comprehensive. The other criteria, such as the capital-output and cost-output ratio, are also imperfect.

A comprehensive approach to comparing efficiency across different farm categories is implicit in Farrell's (1957) arguments discussed earlier. It requires the estimation of production functions. We shall take up this discussion in Section 4.2.

Section 4.2.0 The single input production function

The analysis of production in the present chapter will be conducted by estimating production functions for farms in our villages. We shall first estimate a production function with land as the only input. This will enable us to comment on the size-productivity relationship. In Sections 4.3.1 and 4.3.2 we shall discuss the values of the parameters of single input production functions. In Section 4.4 we shall present a discussion of production functions with three inputs ; land, draught power and new inputs such as seeds and fertilizers. This will enable us to comment on returns to scale and differences across farm size in the intensity of input use.

Clearly, the concept of a production function is an essential tool in our discussion of efficiency in agricultural production in the villages. Thus we shall first introduce the notion of a production function.

Intuitively and at a very general level a production function describes a relationship between a given quantity of output and the quantity of inputs it takes to produce that output. It is essentially a technical relationship between output and inputs, e.g.

$$Y = f(x_1 \ldots\ldots\ldots, x_n)$$

may be called a production function such that Y is output produced by a combination of inputs x_i. This general relationship has been given more specific functional forms resulting in a family of production functions much used in economic analysis. Some examples are Cobb-Douglas, Constant Elasticity of Substitution, Input-Output and Linear Programming production functions. The first two are examples of neo-classical production functions that give smooth production isoquants.

The mathematical properties of production functions as merely technical relationships between outputs and inputs are, in themselves, quite interesting. However, these properties acquire significance for economic theory when they are used in conjunctions with optimizing economic behaviour of producers. For example, profit maximizing, or its dual, cost minimization behaviour by producers, when the underlying technical relationship between inputs and outputs is given by the Cobb-Douglas production function, results in hypotheses on productivity change and technical and cost efficiency that can be empirically tested (Nugent and Yotopoulos (1976)).

In Sections 4.2.1 and 4.2.2 that follow we shall present a discussion of the output and input variables that describe the production function that we shall estimate. In Section 4.2.3 we shall discuss some properties of the Cobb-Douglas production function that we shall use in our analysis. The mathematical transformation of the production function to be estimated, using the ordinary least squares regression method will be specified. Finally, we shall discuss some problems of estimation concerning the ordinary least squares method that arise from the underlying optimizing behaviour of farmers in our villages.

Section 4.2.1 The Value of Farm Output

The variable to be explained in our regression analysis for the four villages is the total value of crops produced on the farm. (In one of the villages, Jatli, the value of wheat output and the value of kharif output will be used as additional dependent variables). It may be argued that taking total farm value as a dependent variable involves aggregation biases and that this assumes away the complicated decision-making process by which farmers allocate inputs with a view to maximizing returns on individual crops. We are sceptical about this implied description of farmers' behaviour. In our interviews we observed that farmers are remarkably aware of, and concerned with, the entire annual cropping season. For example, farmers are well aware that the impact of inputs such as fertilizer overlaps cropping seasons. Thus more fertilizer used during the rainy season was understood to contribute to the yield of the following kharif crop grown on the same plot of land.

The use of total value of farm output as the dependent variable may be undesirable since it implies that farmers are not flexible regarding input allocation within the annual cropping season to adjust to changes in output demand and climate. We shall argue that drastic variations within annual crop seasons are likely to be due to random factors whose effect cancels out in the long run. In a normal year farmers have a reasonable knowledge of the annual cropping pattern at the beginning of the year. This is borne out also by the importance attached by farmers to crop rotation which involves planning of crops and hence commitment of resources. We shall, therefore, argue that it is reasonable to assume that farmers maximize the total value of crop output for given inputs.

Total value of output in our regression analysis is composed of five crops in the 'barani' villages and four crops in the canal irrigated villages. Two comments may be made here. Firstly, we restricted ourselves only to the main crops grown in the villages. This is necessitated by the method of data collection which involved reliance on farmers' recollection of quantities of inputs used and outputs produced. We felt that detailed questions on less important crops resulted in much guess-work by farmers so that the quality of data thus collected may not be very good. (For a discussion of the survey methodology, see Chapter 1.) Secondly, we have included more crops for the 'barani' villages as compared to canal irrigated villages. This appears unsatisfactory, given that canal irrigation enables greater cropping intensity and a wider choice of crop varieties. Our experience suggested that in practice farmers in irrigated areas have a wider choice of minor crops (such as vegetables, fruit and oil seeds) that take up a small percentage of the cultivated area. Most of the land is used for growing a few main crops that have long maturing periods. The standard practice in canal irrigated areas is to grow cotton and maize in the 'kharif' season with wheat as the main 'rabi' crop, while sugarcane is a year round crop. Fodder crops are important in both 'rabi' and 'kharif' seasons, but the output is rarely quantified since it is fed directly to livestock (often livestock is left to graze the standing fodder crop.). In the 'barani' villages wheat is the main 'rabi' crop. In the 'kharif' season groundnuts, maize pulses and bajra are grown. The percentage of acreage devoted to these crops varies considerably with access to irrigation. Farmers with direct access to wells grow mainly groundnuts while farmers without access to wells grow mainly maize. In the 'barani' areas the greater variation in the cropping pattern may be due to the greater variability in soil fertility, as compared to the canal irrigated villages. Tables 4.1 and 4.2 list the crops grown and their prices in the four villages.

The unit of measurement for all crops is maunds (= 40 Kg.). Price of each crop in each village is the modal price received by farmers at harvest time.

Table 4.1 Crops and prices in the 'barani' villages

(Rs per maund ≈ 40 kilos)

Crops	Price in Khunda	Price in Jatli
Wheat	35.20	36.25
Groundnut	118.00	120.00
Maize	31.00	30.00
Bajra	27.50	28.00
Pulses	28.75	29.00

Table 4.2 Crops and prices in the canal irrigated villages

(Rs per maund ≈ 40 kilos)1/.

Crops	Price in Mehdiabad	Price in Chak
Wheat	36.26	35.62
Cotton	97.20	80.00
Maize	38.97	36.20
Sugarcane	77.99	109.55

1/. The big difference in the prices for cotton and sugarcane between Chak and Mehdiabad is explained by the quality of soil for cotton and access to a sugar mill for sugarcane. The cotton varieties sown in Chak are inferior that respond to less regular supply of water. The presence of a sugar mill near Chak increases the demand and hence influences price. In Mehdiabad, sugarcane is grown mainly for domestic consumption.

We may now proceed to define the dependent variable for each farmer in 'barani' and canal irrigated villages :

$$\text{TPROD (barani)} = O_W P_W + O_G P_G + O_M P_M + O_B P_B + O_P P_P$$

$$\text{TPROD (canal irrigated)} = O_W P_W + O_C P_C + O_M P_M + O_S P_S$$

where TPROD = total value of crop output, O is output, P is price for each crop in each village, subscripts W,G,M,P,C and S refer to wheat, groundnut maize, bajra, pulses, cotton and sugarcane respectively.

In village Jatli total value of 'rabi' crop is

$$\text{PRODW} = O_W P_W$$

while the total value of the 'kharif' crop is

$$\text{PRODK} = O_G P_G + O_M P_M + O_B P_B + O_P P_P$$

Section 4.2.2 The Inputs

Land

Land measured in acres is the most important independent variable for the analysis presented in Section 4.3. It is also the most difficult to measure as a pure input not contaminated by the influence of other important inputs applied in the process of production. Ideally, we should measure land in terms of annual value of land used in the production process. Inherent in this measure is a correction for soil fertility and locational differences of individual parcels of land. We did not have access to such an ideal measure. Our data provide two types of information on land. One is the total size of holding in acres and the other is the total cropped area in acres. Size of holding as a measure of land has the disadvantage of including fallow land and ignoring differences in soil fertility. But the advantage is that little guesswork is involved in its measurement. It is there to be seen and any exaggerated claims are soon toned down in the presence of other respondents. Measurement in acres, however, may lead to a problem of dimensionality when everything else in the production process is measured in value. But our main objective in this analysis is to explain the observed phenomenon of diminishing returns to land so that a unit of measure in terms of land size is necessary.

The alternative measure is a farm's total cropped area. This measure excludes fallow land but has all the other features of the size of holding measure. However, in the relevant literature (Rao (1966), Rudra (1968), Bharadwaj (1974)), a controversy revolves around the merit of using this measure. It has been argued that an important explanation of higher productivity on small farms is their ability to crop land more intensively than the large farms. In taking the total annual cropped area as the measure of land input we may correct for the higher cropping intensity on small farms compared to the large farms and thus may get constant returns to land. In Section 4.3. we shall specifically test whether differences in cropping intensity may be suggested as a possible explanation for the existence of the inverse relationship between size and productivity.

Another problem in using size of holding as a measure of land input is that while reporting the farm size, farmers tend to truncate the area to the nearest integer. Complicated fractions are avoided ; ½ being the most frequently quoted fraction. This results in the clustering of observations around integers and halves. An explanation for this may be that while the farmers (especially the smaller farmers) tend to do most of their calculations in 'bighas'(= 0.5 acre) in our unirrigated villages and 'kanals' (= 0.25 bigha) in our 'barani' villages, the interviewers insisted (wrongly with hindsight) on eliciting responses in terms of acres. Thus, strictly speaking, our measure of the size of holding is discrete rather than continuous.

Agrarian issues in Pakistan have been discussed in the context of three size-categories (sizebeing defined in terms of acres owned or rented or a combination of the two). These are small, medium and large farms. Agricultural land is divided into two broad ecological zones; 'barani' and irrigated. A straightforward rule of thumb (that equates 2 'barani' acres with 1 canal irrigated acre in terms of productivity) is then applied to get a national distribution of farms and acreage in the three size-categories. According to this criterion the size-categories are:

Table 4.3 Size-categories of farms in 'barani' and canal irrigated areas

	Small	Medium	Large
'Barani' areas	0-25	25-50	Above 50
Canal irrigated areas	0-12.5	12.5-25	Above 25

See, e.g. Farm Management Surveys, Ministry of Agriculture, Government of Pakistan, 1967, 1968, 1969, 1971; Chaudry and Herring (1974).

This classification involves considerable over-simplification. Not all canal irrigated land consists of uniform soil fertility. Also, 'barani' land with access to well-irrigation 1/ yields crop output that is comparable to yields in canal irrigated areas. More importantly, at a disaggregated

1/. Direct evidence on well-irrigation in our two 'barani'villages is not available. However, the Agricultural Census of 1972 indicates that subdivisions Pindi Gheb and Gujjarkhan (from which Khunda and Jatli, respectively, were selected) have 1.4 and 1.3% of the total acreage irrigated by wells or tube-wells.

level of analysis, small, medium and large sizes are relative. For instance, a farmer cultivating 12½ acres in the 'barani' village Jatli defined himself as a large farmer (as did his neighbours) while a farmer owning the same amount of land in village Khunda considered himself to be a medium-size farmer.

Area cultivated in acres is a useful criterion for defining small, medium and large farms if it can capture the scale effect within the village. The scale effect in Pakistani agriculture is important since it involves differences in economic behaviour that result in differences in productivity. This behavioural variability is captured in arguments that specify dualistic rural factor markets (Sen (1966), Mazumdar (1965)). It is argued that small farms are, typically, family farms where decisions regarding resource allocation are governed by rules that are different from those of medium and large size farms (where market allocates the resources). It is important, therefore, to isolate meaningful cut-off points that distinguish between different size-categories in the sense discussed above. Clearly, these cut-off points, if they exist, are likely to be village-specific.

We decided on our village-specific cut-off points after observing the pattern of residuals around the predicted line estimated by a loglinear regression of the value of output on the size of holding. This was done for each of the four villages. The estimated Durbin-Watson statistics (Table 4.6) indicate that error terms are not independently distributed across households arranged in higher order of size. A plot of the pattern of error terms in each village suggests that the village population of farmers can be broken down into three broad categories. The cut-off points for these three categories, in terms of acres, were then used to define small, medium and large farms in the four villages. These are given in Table 4.4 below.

Table 4.4 Size categories of farms defined in the four villages

	Small	Medium	Large
Khunda	0 - 9	9 - 22	Above 22
Jatli	0 - 5	5 - 10	Above 10
Mehdiabad	0 - 7	7 - 13	Above 13
Chak	0 - 4.5	4.5 - 9.5	Above 9.5

The mean size of holding, total acreage and the number of cultivators in each size category, in each village, are given in Tables 4.23 to 4.27 in the Appendix.

Draught power

Draught power is an important input in agricultural production. The local 'rule of thumb' prescribes a fixed-proportion relationship between draught power and land (a pair of bullocks for every 12½ acres). In practice, however, there is considerable deviation from the conventional norm because of the substitutability between human and bullock labour. (A good ploughman can get more out of a pair of bullocks compared to another.) Another notable feature of draught power is the non-existence, at least in our villages and in Khanewal, of markets for bullock services. (Bliss and Stern (1980), also, report the non-existence of a bullock market in Northern India.) There are informal exchange relationships that are probably governed by pricing rules that involve bartering of services. We did not attempt either to identify or to quantify such prices. (An interesting phenomenon is the growth of cultivation with tractors. This has resulted in a lively market for tractor services.) 1/

Our measure of draught power, as an input in the production process, is the total value of draught animals. It is a stock measure when, in fact, we should use a flow measure. However, that involves pricing

1/. We shall take up the issues regarding tractor use in Chapters 5 and 6.

services of draught animals. But we have noted above that markets for such services do not exist. An alternative is the number of bullock days used for all the crops in the annual cropping season. In the absence of systematic book-keeping we could, at best, hope to get an estimate of the number of tillings per crop and from that calculate the draught power used in all the crops. This is a fairly complicated procedure and one not adopted during the collection of data. We decided, therefore, to use the value of draught animals, as a measure of draught power on the farm, as the explanatory variable in our regression analysis.

In the two 'barani' villages data are available only on the value of livestock owned by a household. We are, therefore, constrained to use this measure as a proxy for the value of draught power. Thus, in the two 'barani' villages, we expect the estimates of marginal productivity of draught power to be biased since the total value of livestock over-estimates the total value of draught animals.

<u>Seeds and fertilizer</u>

Our measure of variable capital used on the farm is the most satisfactory of the inputs we have used. It measures the total value of seeds and fertilizer used in the annual cropping season. The majority of farms in our villages report that these are the two most important farm inputs on which expenditure is incurred. In the two canal irrigated villages the use of fertilizer as well as new high yield variety seeds is very widespread. Farmers show considerable knowledge of both the risks and increments in yields associated with the new varieties of seeds. Different combinations of nitrogenous, phosphate and sulphurous chemicals are used to enrich soils of different fertility. In the 'barani' villages, however, traditional seeds are still in wide use. The adoption of new varieties is quite slow. This is partly a reflection of the fact that in the absence of controlled irrigation, variance in the yields of new varieties is quite high (perhaps higher than for traditional varities that are naturally drought resistent) which results in caution in their application. In Khunda, the use of fertilizer is limited to a few farms only. This is due to a widespread and well-founded belief amongst farmers in the village that crops are 'burnt' by the use of fertilizer if it does not rain at the right time. The few farmers who do use fertilizer have access to well irrigation. In Jatli, well-irrigation is quite widespread. This may explain the greater extent of fertilizer use in this village.

Labour

Farm labour as an input in the production function is of considerable interest. However, the economic implications of the value of the coefficient on labour change with the way labour is measured. (This may not be true in organized labour markets where there may exist a relationship of proportionality between hours worked and the number of workers (Sen (1966)). When mandays worked is used as the measure of labour the coefficient yields an estimate of the marginal product of labour. When, however, the number of workers is used as the explanatory variable, the estimates give the marginal product of a labourer. This distinction lies at the core of a long debate concerning the existence of surplus labour or disguised unemployment in developing countries (Sanghavi (1969), Schultz (1964), Jorgensen (1967)). An implication of the existence of surplus labour is that a part of the labour force may be removed from the agricultural sector without affecting total output. This is fundamental to the model of development suggested by Nurkse (1953). He makes the extreme assumption that the existence of surplus labour implies that the marginal product of labour is zero. Sen (1966) however, has shown that this is neither a necessary nor a sufficient condition for the existence of surplus labour. For surplus labour to exist on a farm, output must remain constant when a family member leaves the farm and that can happen even if the member's marginal product is positive. All that is required is that the remaining members work a little harder. This follows from the assumption of constant marginal disutility of labour for family members working on the farm so that total labour on the farm remains unchanged.

Bliss and Stern (1980) have extended Sen's basic ideas to show that the existence of surplus labour depends on whether or not farms are optimally organized. They compare the allocation of labour on farms where individual members make decisions independently, with farms where allocative decisions are made jointly. Taking the latter to be the more realistic case, they argue that, in equilibrium, family farms are optimally organized since the opportunity cost of labour of all members equals the marginal product of farm labour. It is then shown that optimally organized farms are not characterized by the existence of surplus labour.

Their analysis suggests that the way a farm is organized has important implications for the production functions to be estimated. If farms are organized such that allocative decisions are taken jointly, optimization results and the production function to be estimated should have the number of labourers as an argument. The production function displays constant returns to scale given that the underlying production function in which labour, correctly measured in mandays or hours, has constant returns. This does not follow for other types of farm organization.

The other much-discussed issue is the existence of dualism in the labour market (Sen (1966), Mazumdar (1965)). This aspect of the labour market will be discussed in detail in Section 4.3.2. Basically, the theory posits that farms using family labour cultivate more intensively compared to farms that use hired labour. Here, again, measurement of farm labour is critical. Total farm labour in man days (Saini (1971), Bardhan (1973), Junankar (1976), Lau and Yotopoulos (1971)) gives a coefficient value that measures the joint effect of both family as well as hired labour. This measure of labour is used due to the difficulty of eliciting from the farmers, the quantities of the two distinct labour inputs in terms of man days. An appropriate measure of labour input is obtained by breaking down farm labour into its main activities, i.e. ploughing, irrigating, hoeing, sowing, harvesting and threshing. The first three activities are performed mainly by family labour. Hired labour is used for the last three activities. Aggregating labour days spent on these two categories of farm activities and using these two measures of labour input in the production function would provide a method of testing hypotheses concerning the dualistic structure of the labour market.

In our estimation of the production function we used the number of adult male family workers, working on the farm, as the measure of labour input. This is the only reliable measure of labour input in our data from the four villages. The regression results indicated that in none of the four villages is this variable statistically significant. We may interpret this result in two ways. One is that the marginal product of a labourer is zero but we would have to be agnostic regarding the existence of surplus labour. The other interpretation is that village economies are competitive, labour market is governed by the rule that equates marginal product with the wage rate, and output is proportional to land (Bliss and Stern (1980)). We did not include this variable in our final regressions.

Irrigation

In the estimation of production functions in the four villages we have left out one variable that may be argued to be important. This is irrigation. In 'barani' areas access to irrigation can improve yields dramatically. Similarly in the canal irrigated areas the practice of supplementing existing irrigation by tube-wells is very widespread and has been shown to be quite profitable (G. Muhammed (1965)).

Tube-wells are virtually non-existent in Chak and in the two 'barani' villages. In the former, the sub-soil water is saline whereas in the latter the rocky terrain makes it very expensive to drill tube-wells. In Khunda, two large farmers are building small private dams while in Jatli some well-irrigation is used. Due to the lack of data for irrigation in three of the four villages, we have excluded the analysis of the direct impact of irrigation on productivity. We shall, however, comment on irrigation by comparing our evidence on yields in villages where tube-well and canal irrigation is readily available with yields in other villages.

Section 4.2.3 The functional form

The basic equation used for the analysis of the size-productivity relationship is :

$$\text{TPROD} = f(\text{HOLDCULT}) \qquad (1)$$

where TPROD is total value of output

HOLDCULT is the size of holding in acres

In order to test the hypotheses advanced as theoretical justification for the existence of the inverse relationship between size and productivity, two other equations were estimated. These are :

$$\text{TPROD} = f(\text{HOLDCULT}, \text{FRAGMNTS}) \qquad (1.1)$$

where FRAGMNTS is the number of fragments of the farm.

And

$$\text{TCROP} = f(\text{HOLDCULT}) \qquad (1.2)$$

where TCROP = the total cropped area of the farm.

In the perfect neo-classical world (1) is the complete production function. However, the village economy is not perfectly neo-classical so that two additional variables were included to get a basic general production function.

$$\text{TPROD} = f(\text{HOLDCULT}, \text{WAMALVAL}, \text{MIUT}) \qquad (2)$$

where WAMALVAL is the value of draught animals

MIUT is the expenditure on seeds and fertilizer

We believe that the three inputs in (2) describe the important inputs used in the production process except irrigation (see Section 4.2.2). We have (also in Section 4.2.2) given reasons for not including labour input in (2). An additional reason is that part of labour's contribution may already be captured in the three inputs specified in (2).[1/] An important reason for choosing the three inputs is that in order to carry out a comparison of the villages we must maintain uniformity. The three inputs in (2) are the only important inputs in the production process that are common to all four villages and for which data are available.

1/. This is on account of the strong complementarity between human and bullock labour.

In the estimation of (1) and (2) we experimented with linear and loglinear functional forms. In the linear form (1) becomes:

$$TPROD = CONSTANT + \alpha\ HOLDCULT \qquad (1')$$

In the linear form the relationship between size and productivity depends on the value of the constant term. The relationship is inverse, positive, or constant, depending on whether the constant term is positive, negative (and statistically significant) or equals zero. (1') was estimated for one village, Jatli, for illustrative purposes only. The results for the three dependent variables (TPROD, PRODW and KPROD) have been reported in Table 4.5a.

The log-linear form for both (1) and (2) consistently gives higher R^2 values of the regression equations. Most of the results reported in this chapter are based on this functional form. The theoretical implications of the log-linear form are quite interesting. The functional form traces back to a Cobb-Douglas production function which is the commonly estimated agricultural production (Heady and Dillon (1961)). Writing (1) and (2) as Cobb-Douglas production functions we have :

$$TPROD = A\left[HOLDCULT\right]^{\alpha_1} \qquad (3)$$

where A is a multiplicative technology parameter
α_1 is the elasticity of land measured in acres

$$TPROD = A\left[(HOLDCULT)^{\alpha_1}(WAMALVAL)^{\alpha_2}(MIUT)^{\alpha_3}\right] \qquad (4)$$

where α_2 , α_3 are the elasticities of WAMALVAL and MIUT, respectively.

Taking logs of (3) and (4) we have :

$$LTPROD = \log A + \alpha_1\ LHOLDCULT \qquad (5)$$

and,

$$LTPROD = \log A + \alpha_1 \; LHLDCULT + \alpha_2 \; LWAMAVAL + \alpha_3 \; LMIUT \qquad (6)$$

(5) implies that the relationship between size and productivity is negative, positive or constant, depending on whether $\alpha_1 \lesseqgtr 1$. This equation has been estimated for all four villages and also for the small farmers, separately, in the four villages. Thus, several versions of (5) have been estimated.

We shall interpret the constant term log A in (5) and (6) as the measure of technological efficiency. For a given α , a production function with a higher value of log A in one village (or size-category), will be interpreted to imply greater technical efficiency for that village compared to other villages (or size-categories). In terms of Farrell's measure of technical efficiency (Section 4.2) this implies an isoquant that lies below II' given that II' measures the technical efficiency of the other villages (or sizes-categories) (holding output constant)

We shall often compare the estimates of equations (5) and (6) for different villages (sizes). To do so we shall use formal statistical tests to indicate differences between villages (sizes). Two standard procedures are available. One procedure is to use the Chow test (1960).

This test involves the comparison of residual sum of squares of the restricted equation (RSS) with those of the unrestricted equation (URSS) In the restricted equation, we hypothesize the coefficient values to be the same for all villages. In the unrestricted equation we allow the coefficients to be different in all villages. The computed statistic has an F distribution. If, for example, two groups are to be compared, the restricted equation is estimated by pooling observations for the two groups. The unrestricted residual sum of squares are then calculated by the addition of (RRSS) for each of the two estimated equations for the two groups. The computed statistic is :

$$F = \frac{(RRSS - URSS) / (k+1)}{URSS / (n_1+n_2-2k-2)} \qquad F \; (k+1),(n_1+n_2-2k-2)$$

A drawback of this procedure is that it tests the overall relationship between two (or more) groups without specifying whether the tested differences are on account of the slope coefficients or intercept terms.

An alternative approach is to incorporate dummy variables for both slope as well as the intercept term in equation (5) (or (6)). So that, for comparing two villages, V_0 and V_1, we have :

$$LTPROD = \log A + \alpha_0 D_1 + \alpha_1 \text{ LHOLDCULT} + \alpha_2 D_{11} \qquad (7)$$

where D_1 = 1 when an observation comes from V_1, 0 otherwise
D_{11} = HOLDCULT when an observation comes from V_1, 0 otherwise

If α_0 is statistically signficantly different from zero the coefficient on the intercept term for V_1 is $(\log A + \alpha_0)$ while the coefficient on the slope term for V_1 is $(\alpha_1 + \alpha_2)$. The intercept and slope term coefficients for V_0 are log A and α_1, respectively. This method allows us to distinguish between sources of difference between the two groups. A problem with this approach arises due to the possibility of multicollinearity between the independent variables, D_1 and D_{11}, which reduces the reliability of the estimates. We should, therefore, interpret our regression results with some caution.

Equation (6) has been estimated for all four villages, for three size categories (small, medium, large) in each village, for 'barani' and irrigated farms separately and finally for all the farms in the four villages taken together. Thus, altogether, nineteen regressions based on equation (6) have been estimated.

The log form used in our regression analysis is restrictive in one important sense. It allows for the inclusion of only those households who have non-zero values for the variables in (5), (6) or (7). Thus we have been forced to drop some households. However, the number of households thus left out is rather small.

The estimation of Cobb-Douglas production function yields elasticities that have straightforward economic interpretations. Marginal productivities are easy to calculate (since elasticity $\eta = \frac{MP}{AP}$) and returns to scale follow directly : Thus

$$S = \Sigma \alpha_i \qquad i = 1 \text{ to } 3$$

and we have increasing, constant or decreasing returns to scale according as $S \gtreqless 1$. However, we need to make the strong assumption of unit elasticity of substitution between inputs. But this has been shown to be a reasonable assumption (Bardhan (1973)).

We shall next discuss some estimation problems associated with the behavioural production function of the type that we propose to analyse

Suppose we specify a production function

$$Q = f(X_1 , \underset{\sim}{x})$$

where Q is output, X_1 is land, $\underset{\sim}{x}$ is the vector of all other inputs.

In the perfect, neo-classical, world all inputs (including management) are perfectly divisible and marketed, and the function f is the same for all farmers. Cost minimization, with prices the same for everyone, implies that factor ratios are equal for all farmers. Output, therefore, is proportional to land. There would be no point in including other inputs in the production function since they would be perfectly collinear with land ; the estimated parameters of such a production function would be unreliable.

The other problem arises due to the simultaneous nature of decision-making that underlies behavioural production function. Profit maximization by farmers given perfect markets and the absence of uncertainty leads to inconsistent and biased estimates of parameters when ordinary least square regression procedure is used. This is due to the correlation between the explanatory variables and the error term, (Marschak and Andrews (1949), Walters (1963a)). An example of this, in the Indian context, may be seen in the controversy between Hopper (1965, 1967) and Nowshirvani (1967)).

Hopper (1967) estimated production functions using ordinary least square regressions (for 43 farms in a village in Northern India) in which expected output on the farm was regressed on inputs actually used. He concluded that in technologically stagnant agriculture, resource allocation is rational in the sense that farmers seek to maximize profits from given inputs and their prices. Questioning Hopper's estimation procedure, Nowshirwani (1967) argued that profit maximizing farmers adjust inputs given their knowledge of the residuals . Thus farmers with higher residuals apply more inputs to equate the value of marginal products with input prices and we have a situation where both output as well as inputs are correlated with the error term. This violates a basic assumption of the ordinary least square regression procedure and the estimated parameters are inconsistent and biased. Thus no conclusions regarding allocative efficiency can be drawn from Hopper's estimates.

Our village economies are different from the neo-classical paradigm. Factor markets in our villages are imperfect in a number of ways. Differences in access to inputs result in different factor prices across farm size. The dualistic nature of factor markets was discussed in detail in Section 4.2.2. Further, response to uncertainty in agriculture also varies across farmers. An additional feature of our village economies is the differences in skills across farmers. These skills cannot be marketed easily so that the assumption of identical production functions for all farmers is unrealistic. In our discussion of the measures of explanatory variables in the previous section, we noted a number of problems due to inaccuracies in measurement. All these features of our villages imply that factor price ratios are likely to vary across farms so that output may not be strictly proportional to land and the multicollinearity between inputs may not be a serious problem. Differences in skills across farms and measurement problems are also likely to produce variation across farmers so that the production function is a meaningful concept in our villages. Finally, farmers may have only an imperfect knowledge of their residuals so that inputs may be adjusted imperfectly. This adjustment may also be influenced by differences in factor price ratios across farms. Thus the problem of inconsistency and bias pointed out by Nowshirwani may not be very serious for the parameters that we shall estimate.

Definition of variables

The variables that we shall use in our discussion in the remaining sections of this chapter are as follows :

TPROD, PRODW, KPROD = value of total, wheat and kharif output.

HOLDCULT = Size of holding (≡ land owned + land rented in − land rented out)

FRAGMNTS	=	Fragments
TCROP	=	Total cropped area on the farm
WAMALVAL	=	Value of draught animals on the farm
MIUT	=	Value of expenditure on seeds and fertilizers

In many cases we shall be using log forms of variables, in which case, letter L will be attached in front of the variables. For example,

$$\log_{10} \text{TPROD} = \text{L(TPROD)}$$

Dummy variables will also be used but these will be defined whenever they are used.

Section 4.3 The evidence and some explanations

Section 4.3.1 The regression results

In the present section we shall present our regression results. In Section 4.3.2 we shall offer some interpretations and explanations for our results.

We first take village Jatli as an example and report the results for the size-productivity relationship by estimating both linear and log-linear forms. The results are given in Table 4.5 a and b. The R^2 values of the regressions for all three dependent variables, TPROD, PRODW, and KPROD, are quite low for the linear form. The values of the intercept term (CONSTANT) are consistently positive implying diminishing returns to land. This result is confirmed by the estimates for the log-linear form presented in Table 4.5 b. The value for the slope coefficient is less than one for the three dependent variables. Judging by R^2 values the log-form is a better fit. A comparison of the slope coefficients of HOLDCULT for PRODW and KPROD indicate that diminishing returns set in earlier (i.e. for a smaller size of holding) in the 'kharif'

Table 4.5 a Regression of output on the size of holding in Jatli

(linear form)

DEPENDENT VARIABLES 1/ / INDEPENDENT VARIABLES	TPROD	PRODW	KPROD
HOLDCULT	73.86 (34.56) 2/	47.96 (40.06)	25.91 (16.51)
CONSTANT	1430.06 (106.91)	860.20 (106.34)	569.86 (65.90)
R^2	0.16	0.18	0.08
N	183	183	183

Table 4.5 b Regression of output on the size of holding in Jatli

(log-linear form)

DEPENDENT VARIABLES 1/ / INDEPENDENT VARIABLES	TPROD	PRODW	KPROD
HOLDCULT	0.71 (278.67) 2/	0.62 (265.64)	0.58 (54.00)
CONSTANT	2.71 (6884.96)	2.51 (6899.09)	2.35 (829.72)
R^2	0.62	0.61	0.26
N	171	171	101

1/. For definition of variables, see pp. 145,146.

2/. In all the tables that follow values in brackets are F values. ($t = \sqrt{F}$)

season. Another result worth noting is that when the entire annual crop output, (TPROD) , is taken into consideration the coefficient value of HOLDCULT is higher relative to the two separate crop seasons.

We shall comment briefly on the results presented in Table 4.5 a. and 4.5 b., since this is the only occasion when we present results for different crop seasons . Poor returns per acre on the larger farms in the 'kharif' season may be explained by the popular practice of leaving land fallow for grazing etc. by such farms. Large farms may choose to have a larger value of livestock rather than grow 'kharif' cash crops such as groundnuts, particularly when the requirements of irrigation are greater for the 'kharif' season crops. We noted in our discussion in Section4.2.2that,typically, a smaller proportion of the total farm area is irrigated on the larger farms. Further, rearing livestock may be less labour intensive compared to growing groundnuts. Earlier (Chapter 3, Section 3.4) we noted the impact of the introduction of groundnuts on the rural labour market. We shall be arguing later in this section that small farms have a distinct advantage over large farms regarding both the quality as well as the quantity of labour.

In Table 4.6 we have presented results, based on the log-linear form the relationship between size and productivity in the four villages. It can be seen that diminishing returns are strongest in Khunda followed by Jatli and Mehdiabad. In Chak, the coefficient value for HOLDCULT is 0.90 which is closest to constant returns.

In Table 4.7 we have grouped together our villages into 'barani' (rain fed) and irrigated villages. It can be seen that the value of the coefficient for HOLDCULT is smaller in the 'barani' villages compared to the canal irrigated villages and the differences are rather large. An

Table 4.6 Regression of Total Value of Output on the size of holding I.

Dependent variable[1/]: log 10 (TPROD) (log-linear form)

VILLAGES / INDEP. VARIABLES	Jatli	Khunda	Mehdiabad	Chak
log 10 (HOLDCULT)	0.71 (278.67) [2/]	0.67 (102.62)	0.78 (104.85)	0.90 (203.28)
CONSTANT	2.71 (6884.96)	2.30 (784.59)	3.18 (1280.63)	2.89 (2346.01)
R^2	0.62	0.35	0.60	0.67
N	171	189	71	104
S.E		0.31	0.29	0.23
R.S.S.	7.44	17.91	5.51	5.22
D.W. [3/]	1.93	1.70	1.41	2.33

1/. For definition of variables, see pp. 145, 146.

2/. Values in brackets are F values.

3/. To calculate the Durbin-Watson statistic, D.W., we arranged households by increasing order of HOLDCULT. D.W. statistics in all four villages are significant. N, S.E. and R.S.S. are the number of households, the standard error of the regression and residual sum of squares, respectively.

Table 4.7 Regression of Total Value of Output on the size of holding II

Dependent variable : log 10 (TPROD) 1/ (log-linear form)

VILLAGES / INDEP. VARIABLES	ALL VILLAGES	BARANI VILLAGES	IRRIGATED VILLAGES
log 10 (HOLDCULT)	0.52 (136.13) 2/	0.39 (104.85)	0.89 (328.31)
CONSTANT	2.86 (3741.97)	2.76 (4735.35)	2.96 (3353.00)
R^2	0.20	0.23	0.66
N	535	360	175
S.E	0.46	0.32	0.26
R.S.S.	105.93	37.37	12.01

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F values.

important explanation may be the availability of irrigation facilities to the large farms in the canal irrigated villages. This improves the fertility of soil and increases yields. Thus, differences in the fertility of soil, across farm size, may be less marked in the canal irrigated villages. We shall be arguing later that soil fertility may be a crucial factor in determining the nature of the relationship between size and productivity.

We used a formal statistical test to determine whether the differences in the slope and intercept of the four villages were significant. We estimated a regression equation in which the differences in the two parameters are captured by introducing two dummy variables, each, for Jatli, Mehdiabad and Chak and comparing their estimated values with those of Khunda. Our regression equation is :

$$\text{LTPROD} = \text{CONSTANT} + \alpha_0 D1 + \alpha_0 D3 + \alpha_0 D4 + \alpha_1 \text{ L HOLDCULT} + \alpha_1 D11$$

$$+ \alpha_1 D31 + \alpha_1 D41$$

where D1, D3, D4 are the intercept dummies for Jatli, Mehdiabad and Chak respectively.

and D11, D31, D41 are the slope dummies for Jatli, Mehdiabad and Chak, respectively.

Results for the regression equation are presented in Table 4.8. It can be seen that the slope dummy for Jatli, D11, is statistically insignificant. This implies that one cannot reject the hypothesis that returns to land are similar in the two 'barani' villages, Jatli and Khunda. The slope dummy for Mehdiabad, D31, is significantly different from zero at 10% level of significance. This is quite low and suggests that we must be cautious in accepting the apparent differences in returns

Table 4.8 Regression of Total Output on size of holding for all villages

Dependent variable : log 10 (TPROD) (log form)

INDEPENDENT VARIABLES 1/	ALL POPULATION
log 10 (HOLDCULT)	0.67 (143.42)
D 11	0.04 (0.30)
D 31	0.11 (1.54)
D 41	0.24 (6.55)
CONSTANT	2.30
D 1	0.41 (26.61)
D 3	0.88 (69.90)
D 4	0.59 (38.65)
R^2	0.73
F	201.90
N	535
S.E.	0.26
R.S.S.	36.12

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F values.

to land between Mehdiabad and Jatli. For Chak, however, the coefficient value for the slope dummy, D41, is statistically significant and is quite high. We can be confident in interpreting this result as indicative of the difference between this village and the 'barani' villages regarding returns to land.

A similar interpretation of the intercept dummies indicates that differences between villages are quite sharp where technical efficiency is concerned. The three intercept dummies are significantly different from zero.

In Table 4.9, below, we have ranked the four villages (using criterion of statistically significant differences in slope and intercept dummies) according to the magnitude of returns to land and technical efficiency.

Table 4.9 The ranking of villages by criteria of efficiency

Village	Technical Efficiency	Returns to land
Khunda	0	0
Jatli	1	0
Mehdiabad	3	1
Chak	2	2

On the basis of the regression results presented so far we may suggest the following conclusions regarding the relationship between farm size and productivity:

(i) Returns to land diminish as the size of holding increases in all four villages.

(ii) Returns to land are higher in the irrigated villages as compared to the 'barani' villages.

(iii) Within 'barani' villages, technical efficiency is higher in Jatli. Returns to land are similar.

(iv) Within irrigated villages, returns to land are higher in Chak. We cannot comment on the relative technical efficiency since the coefficients of HOLDCULT are significantly different in the two villages.

Section 4.3.2 Some explanations

Conclusion (i) is consistent with the empirical results found in India (discussed in detail in Chapter 2) where a much larger data base was used to show the existence of an inverse relationship between the size of holding and productivity in different agricultural zones. If we accept the statistical nature of this relationship, we have to provide economic reasons for its existence. Three hypotheses may be suggested here :

H.1 Small farms are endowed with superior quality of land as compared to large farms.

H.2 Small farms allocate greater labour per unit of land compared to large farms.

H.3 Small farms are better endowed with some essential complementary input such as irrigation.

The empirical validity of all three hypotheses has been investigated in the Indian context. We noted that Khusro (1964) estimated the relationship between size of holding and productivity correcting for differences in soil fertility. He used land revenue as an index of soil fertility. This measure is not satisfactory since land revenue reflects considerations other than principles of taxation (thus land revenue is often much below the pure economic rent of a parcel of land). However, in the absence of a more reliable measure of fertility, this proxy variable gives good results in Khusro's regression analysis. With its introduction, the elasticity coefficient of the size of holding approaches unity indicating the importance of H.1 in the existence of the inverse relationship.

Our indirect test for H.2 is the pattern of cropping intensity on farms of different size. The results are given in Table 4.10.

Table 4.10 Regression of total cropped area on the size of holding (log-linear form)

Dependent variable : log of Total Cropped Area 1/

VILLAGE / INDEP. VARIABLE	Khunda	Jatli	Mehdiabad	Chak
log (HOLDCULT)	0.79 (280.94) 2/	0.84 (706.40)	0.89 (156.62)	0.91 (197.68)
CONSTANT	0.20 (11.68)	0.11 (19.20)	0.02 (0.06)	-0.18 (8.66)
R^2	0.60	0.81	0.69	0.66
N	189	171	71	104

1/. For definition of variable, see pp. 145, 146.

2/. Figures in brackets are F values $(t = \sqrt{F})$

In all the villages the estimated value of the coefficient of log (HOLDCULT) is significantly less than one when the dependent variable is the log of total cropped area. This indicates that cropping intensity declines as the size of holding increases in all villages.

In a labour intensive technological environment it is reasonable to assume that labour requirements increase proportionately with cropping intensity. Our results,therefore,imply that the small farms use more labour on the farm. (This result is to be contrasted with those presented in Table 4.12 and discussed later in this section).

C.H.H. Rao (1968)advanced H.3. He found that the introduction of an additional variable,such as percentage of area under irrigation, increases the value of the land coefficient. This implies that an important explanation for higher output on small farms may be their better access to irrigation.

We have seen that the empirical validity of the three hypotheses is well-established in the Indian context . But there are a priori arguments that form the rationale for the hypotheses before they are empirically tested. We shall discuss some of these a priori justifications in order to examine their relevance to our four villages.

Sen (1964) suggests a demographic argument for justifying H.1. He argues that given some initial state of land distribution, high quality land yields higher output and thus is able to maintain larger families. This process takes place in an environment where laws of inheritance ecourage fragmentation of farms. The outcome is a higher concentration of small size farms on better quality land. The plausibility of this argument rests on the assumption of a closed village economy with few possibilities of emigration. This is quite reasonable since migration possibilities for the small peasant proprietor have opened up (on any meaningful scale) in the last twenty years (Helbock (1975),Eckert (1972)). It may be too early yet for migration to reverse the process of land concentration (through the consolidation of small farms).

An implication of Sen's argument is that in villages where the

the demographic process is in its early phases (so that differences in the soil fertilitybetween large and small farms are not so sharp), we should expect to observe greater value of the land coefficient (when log of output is regressed on the log of land) as compared to villages where the demographic process has been in operation for a longer period of time. This implication is confirmed by our conclusion (ii) based on the evidence presented in Table 4.6. We saw that in both the canal irrigated villages the value of the land coefficient is considerably higher than in the two 'barani' villages. The two canal irrigated villages lie in the canal colonies that were opened up for settlement in the early decades of this century. The two 'barani' villages, on the other hand, are several centuries old. It is reasonable to argue that the higher coefficient values in the canal irrigated villages are on account of the earlier phases of the demographic process as compared to the two 'barani' villages. Higher technical efficiency in Chak and Mehdiabad, compared to Khunda and Jatli, may be explained by the availability of canal irrigation.

An alternative process by which small farms get concentrated on better quality land is the distress sales argument suggested by Bhagwati and Chakravarti (1971). It is argued that at times of distress farmers hold on to the most fertile portions of their land. The worst parcels of land are sold off and these are bought by the larger farmers. Thus, larger farms have poorer quality of soils compared to small farms. This argument goes further than H.1 and asserts that because of the distress sales process the large farms have a greater number of fragments per farm. This lowers the return to land on the large farms by increasing the costs of cultivation.

The evidence on fragmentation from our four villages has been presented in Tables 4.11 a to 4.11 c. Tables 4.11 a and b indicate that while the total number of fragments per farm are indeed greater on the large farms, fragments per acre are greater on the small farms. It is not clear which of the two variables is important in causing diseconomies due to fragmentation. In Table 4.11 c we have presented the regression estimates of an equation in which, in addition to HOLDCULT, we introduce fragments as an explanatory variable. (The variable is significant in Jatli only.) For the distress sales argument to hold, the introduction of fragments in the regression equation should result in raising the value of the coefficient HOLDCULT since the new variable picks up the influence of fragmentation on the returns to land across farm size. However, Table 4.11 indicates that the value of the coefficient on HOLDCULT falls, compared to its value given in Table 4.6, as a result of introducing the additional independent variable .

On the basis of the evidence from our villages, we would have to be sceptical about the validity of the distress sales argument advanced in support of H.1. The evidence, however, is indirect. In a detailed village survey it should be possible to check 'patwari' records to see whether land sales, in fact, took place at times of distress and whether land exchanged hands between farmers who are currently small and large farmers in the village. The quality of land thus exchanged can also be determined. Unfortunately we do not have access to 'patwari' records to comment on this aspect of the distress sales hypothesis.

It is worth noting that the coefficient value of FRAGMNTS is significantly positive in Table 4.11 c. One interpretation of this might be that the number of fragments per farm are really a proxy for a size effect that influences access to resources that raise the total value of output on the farm. In Chapter 6 we shall discuss some of the arguments that suggest that large farmers have better access to the new 'green revolution' inputs. It may be argued that, typically, it is only a

Table 4.11 a Number of fragments per acre on farms of different size categories

	Khunda	Jatli	Mehdiabad	Chak
Small	0.48	1.96	0.30	0.44
Medium	0.22	1.25	0.11	0.21
Large	0.07	0.89	0.06	0.11

Table 4.11 b Number of fragments per farm on farms of different size categories

	Khunda	Jatli	Mehdiabad	Chak
Small	2.20	5.05	1.35	1.11
Medium	3.08	9.41	1.16	1.41
Large	2.52	14.71	1.54	i.80

Table 4.11 c Regression of the total value of output on HOLDCULT and FRAGMNTS [1/] in Jatli (log form)

Dependent variable L(TPROD)

INDEPENDENT VARIABLES	STATISTICS
L(HOLDCULT)	0.65
L(FRAGMNTS)	(168.64) [2/]
L(FRAGMNTS)	0.11
	(4.00)
CONSTANT	2.66
R^2	0.63
F	143.19
N	170

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F values.

sub-set of the large farmers who are 'progressive' in terms of the use of new inputs. Further, such farmers may have increased the size of their holdings out of the savings accumulated from the returns to their entrepreneurial abilities . Such additions to the original farm size also increase the number of fragments on the large farms as seen in Table 4.11 b. Thus the introduction of fragments in the regression equation acts as a proxy for the true variable which may be entrepreneurial ability.

The third argument suggested in support of H.1 is that tenancy contracts result in better quality land on large farms being parcelled out to small tenants (Khusro (1964)). The theoretical issues involved in determining tenancy contracts are complicated and are the subject of a whole chapter. We shall postpone the discussion on tenancy to Chapter 5. For the moment, we shall consider the empirical evidence to test Khusro's argument that the inverse relationship between size and output may be explained by the concentration of tenanted holdings amongst the small farms. In Table 4.12 we have presented the regression results showing the relationship between size and the total value of output for pure owner-cultivators.

Table 4.12 Regression of the value of total output on the size of holding on owner-cultivated farms only (log-linear form)

Dependent variable : L(TPROD)

VILLAGE / INDEP.VARIABLE	Khunda	Jatli	Mehdiabad	Chak
L(HOLDCULT)	0.66	0.69	0.73	0.89

All coefficients are significant at 5% level.

Clearly, the inverse relationship persists. Also, the coefficient values are not very different from those reported for all farmers in Table 4.6 on p. 149 . This suggests that the presence of tenants does not affect the basic inverse relationship between size of holding and the value of total output.

Our discussion indicates that the strongest argument in support of H.1, thereby justifying our conclusion (i) that there exists an inverse relationship between size and productivity, is the demographic argument suggested by Sen. We have also noted that an extension of this argument explains our conclusion (ii).

It is important to note that the three arguments given in support of H.1 make the common assumption that the quality of soil is an exogenous factor that is beyond the control of the farmer. It is not certain, however, that land quality is exogenous. It can be improved by careful agricultural practices (such as crop rotation, application of manure etc.). To the extent, therefore, that quality of soil itself is determined by the size of farm, we should be careful in interpreting H.1 as an explanation for the existence of the inverse relationship between size and productivity.

Next, we shall consider H.2 and H.3 as possible explanations of the existence of the inverse relationship.

H.3 suggests that the inverse relationship between size and productivity is explained by the abundant availability of some important complementary factor, such as, irrigation. Higher percentage of irrigated area on small farms (when irrigation is not the result of a public project, such as, canal irrigation) may be accounted for by any of the three arguments advanced in support of H.1. Irrigation is now treated as another feature of soil quality. Thus, in many rural areas of Punjab, farm size is described not so much by acres owned but in terms of the number of wells owned. In the division of plots the source of, and access to, irrigation is an important consideration. Thus Sen's demographic argument is likely to hold for H.3 as well. Similarly, the distress sales hypothesis implies that land at a greater distance from the irrigation source is likely to be put up for sale first. Further, tenants minimizing risk will insist on access to the source of irrigation while renting land. Thus H.3 is really the same as H.1 and the two hypotheses have similar implications for the relationship between size and productivity.

A rationale for H.2, the labour-based hypothesis explaining our conclusion (i), may be sought in the dualistic structure of the rural labour market. In the context of our discussion, dualism implies the existence of two main farm categories : farms that use mainly hired labour and family farms. The two sets of farms are distinguished by the difference in the opportunity cost determining the allocation of labour. Small farms work with lower opportunity cost of labour than large farms. The wage gap implied for the two sets of farms (or sectors) is the main feature of several growth models (Lewis (1954), Fei and Ranis (1964), Jorgensen (1961), Dixit (1968), Stern (1972)). Several arguments may be suggested to explain the existence of the gap. There are at least two variants of the surplus labour argument discussed in Section 4.2.2 that may be suggested as possible explanations. One is the assertion of the existence of zero marginal productivity of labour on family farms while the labour-hiring farms are argued to have a positive marginal product of labour. We have already seen that the existence of zero marginal productivity is neither a necessary nor a sufficient condition for the existence of surplus labour. Both, intuitively and empirically, it is hard to accept that the marginal product of labour can be zero. Surplus labour with a positive marginal product, as an explanation for the wage gap, is more plausible but we have seen in Section 4.2.2 that on optimally organized farms where decisions are taken jointly surplus labour may not exist.

The existence of the wage gap may be explained by the high psychic cost of hiring out labour services in the market as opposed to working on the family farm where joint family decisions may make work less painful. This would imply a lower disutility of work on the family farm compared to the labour-hiring farms. Another argument may be that farms purchasing labour in the market are prepared to pay higher wages to reduce turnover rate and thus improve efficiency. Yet another set of arguments may be advanced on the basis of the hypotheses suggested by the literature on efficiency wages (Stiglitz (1976), Leibenstein (1966) Bliss and Stern (1977)). The last two lines of reasoning imply that the wage gap may be explained by the desire of labour-hiring farms to achieve higher productivity through greater labour effort.

The implication of the existence of wage gap is that the small farms have lower opportunity cost of labour and therefore allocate more labour per unit of land compared to the large farms. The conceptual problem with this argument arises on account of the empirical evidence that shows that small farms not only use hired labour but also sell labour services in the market (Rao (1968), Khusro (1964)).

This suggests that small family farms participate actively in the rural labour market. Thus, while allocating labour on their farm they <u>should</u> treat the going market wage as the true opportunity cost of labour. The use of a lower opportunity cost can be justified only in terms of an absence of search and transportation costs when working on the family farm. The psychic factor discussed above may also be important.

Mazumdar (1965) has given a rigorous analytical argument to explain why the marginal cost of labour supply is lower on the family farm. He divides the agricultural season into a slack and a busy season. In the busy season the marginal cost of labour supply is the same for the family farm and the large farm. But in the slack season small farms use only family labour so that the marginal cost of labour for such farms is lower than for the large farms in the same period. Therefore, the overall marginal cost of the supply of labour being a composite of the two seasons, is lower for family farms.

A comprehensive test for the argument presented above requires the marginal product of labour (measured in mandays) on small farms to be lower than on the large farms. We have already seen (Section 4.3.2) that we do not have a measure of labour input in mandays. We, therefore, used an alternative procedure for testing H.2 and the arguments supporting it. [1/]

Evidence from the four villages, presented in Section 4.3.4, does not support the view that small farms rely exclusively on family labour or that large farms use hired labour only. In order to test H.2 we introduced intercept and slope dummies for hired labour into a regression of TPROD on HOLDCULT. DL is the intercept dummy taking the value 1 if a farm uses hired labour, 0 otherwise, while D1L is the slope dummy. If H.2 is true, we expect the value of the coefficient of D1L to be significantly negative implying that the coefficient value of HOLDCULT for farms using hired labour in comparison to farms using family labour only. The coefficient of HOLDCULT, therefore, measures the relationship between size and productivity for farms using family labour only. The coefficient sign for the intercept dummy, DL, will indicate

---

1/. Several farm management studies conducted in Pakistan (Farm Managament Surveys 1967, 1969, 1971) consistently report that small farms use greater labour in mandays per acre compared to medium and large size farms.

whether farms using hired labour are technically more efficient. The results for three of the villages are presented in Table 4.12. (Chak has been excluded because data on hired labour are not very reliable in this village.) We see from the table that the slope dummies are statistically insignificant in all three villages. This implies that there is no significant difference in productivity between family farms and farms using hired labour. We therefore reject H.2. Further, in Jatli,the intercept dummy is significantly positive. This may reflect differences in attitude towards technologically advanced practices of cultivation. It suggests that farms hiring labour seek to maximize profit and thus use inputs such as fertilizer and high yield variety seeds more intensively, given that their rates of return are quite high.

In Chapter 2 we discussed a model suggested by Srinivasan (1972) which indicated that allocation of higher labour input on small farms may be explained as rational farmer response under uncertainty. It was shown that, given Arrow's postulates on relative and absolute risk aversion and a market wage rate that exists with certainty, farmers allocate more labour on irrigated land than on unirrigated land since the expected return on the former are higher. He then assumes that small farms, in general, have a higher percentage of cultivated land under irrigation. From these two results it follows that small farms allocate more labour per acre and hence get more output per acre. Although,the analytic rigor of Srinivasan's conclusions is appealing, their validity depends crucially on the assumption about the nature of risk aversion. Bliss and Stern (1980) have shown that when absolute risk aversion is important in the decision making of the farmer, i.e. farmer's income from the less risky (non-farm assets) increases, the allocation of the variable input and hence output may be proportional to farm size.

Table 4.13 Regression of total value of output on the size of holding and hired labour (log-linear form)

Dependent variable : L(TPROD) 1/

VILLAGES / INDEP.VARIABLES	Khunda	Jatli	Mehdiabad
L(HOLDCULT)	0.64	0.69	0.93
	(53.80) 2/	(107.33)	(9.45)
DIL	0.03	-1.10	-0.16
	(0.04)	(1.22)	(0.27)
CONSTANT	2.32	2.65	3.08
DL	-0.02	0.20	0.06
	(0.004)	(9.58)	(0.03)
R^2	0.36	0.66	0.62
F	33.98	107.42	36.35
N	189	171	71

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F values.

The regression equation is :

$$L(TPROD) = CONSTANT = \alpha_0 DL + \alpha_1 L(HOLDCULT) + \alpha_2 D1L$$

DL is the intercept dummy in each village.

D1L is the slope dummy in each village.

to farm size.

It is not generally true that small farms have a higher percentage of acreage under irrigation . We have already discussed the existence of the inverse relationship between size and productivity in the two canal irrigated villages (Table 4.6). However, in neither of the two villages is there a systematic difference in access to irrigation between large and small farmers as far as canal irrigation is concerned (which is the main source of irrigation). In Mehdiabad, our only village with tube-well irrigation, large farms appear to have greater access to water (Table 4.4). We see, therefore, that Srinivasan's argument rests on assumptions that are not always supported by evidence.

Table 4.14 Tube-well irrigation in Mehdiabad

	(1)	(2)
Small	6.00	6.00
Medium	10.00	8.40
Large	30.00	37.70

(1) is the percentage of farmers reporting the use of tube-wells.

(2) is the percentage of area irrigated with tube-wells.

A variant of H.2 the labour-based hypothesis is that by and large, on small farms, the proportion of family labour to hired labour is higher compared to the large farms. This facilitates supervision so that the quality of labour as opposed to its quantity is likely to be better on small farms contributing to greater productivity. Another aspect of supervision is concerned with general farm management that comes with familiarity with the farm and the tasks performed on it. The size factor here is likely to be crucial. Given the general state of technical knowledge and the practice of self-managing the farm, a small farmer is likely to be better acquainted with the farm and the tasks that need doing as compared to a large farmer. Thus,overall management is likely to be better on small farms.

H.1 to H.3 suggest different arguments for expecting higher productivity on small farms as compared to large farms. We have seen that on the basis of the evidence available from our villages we would have to be sceptical about the validity of H.2 and H.3. Regarding H.1, Sen's argument (that suggests favourable endowment of soil fertility on the small farms as a consequence of the demographic patterns) is the most appealing explanation. However, we stress that we do not have sufficient data to test comprehensively each of the three hypotheses in the four villages. A somewhat indirect test of the three hypotheses, taken jointly, can be carried out by a re-arrangement of the data. Each of the hypotheses suggests that small farms are more efficient because they are endowed with some special factor that is qualitatively (land) superior or quantitatively in greater abundance (labour), compared to large farms. We should, therefore, expect small farms to be characterized by constant returns to land whereas the entire village population is characterized by diminishing returns to land due to the lower productivity of large farms.

Table 4.15 presents the regression results for small farms when LTPROD is regressed on LHOLDCULT in the four villages. In each village, small farms are defined according to the criterion discussed in Section 4. 2.2 It can be seen that small farms in Chak, Khunda and Mehdiabad have approximately constant returns to land. Thus an overall test suggests that small farms behave differently from large farms. This difference may be explained mainly by the access to better quality soil. Factors such as greater use of labour and better supervision may also be important.

Table 4.15 Regression of total value of output on the size of holding of small farms only (log-linear form)

Dependent variable : L(TPROD) 1/

VILLAGE / IND.VARIABLES	Khunda	Jatli	Mehdiabad	Chak
L(HOLDCULT)	1.02	0.67	1.03	1.05
	(16.33) 2/	(77.98)	(31.19)	(26.57)
CONSTANT	2.03	2.71	3.02	2.83
	(89.87)	(5004.01)	(628.98)	(759.71)
R^2	0.31	0.45	0.60	0.47
N	39	99	23	32

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F values.

The arguments presented above may now be used to explain conclusions (iii) and (iv) based on Table 4.9, p.153, which state that technical efficiency is higher in Jatli (given that the returns to land are similar) compared to Khunda amongst the 'barani' villages, and returns to land are higher in Chak amongst the two canal irrigated villages. We have seen that small farms (due to a combination of H.1, H.2 and H.3) have constant returns to land while the village aggregate farming population shows diminishing returns. This suggests that in villages with a high concentration of land amongst the small farmers, we should expect to see relatively higher village-wide returns to land. In Chapter 3 we argued that the Gini coefficient is a good measure of the concentration of land in the villages. In Table 4.16 we have reproduced the values of the Gini coefficient for land concentration in all four villages. Taking the two irrigated villages first, we note that the value of the Gini coefficient is lower in Chak compared to Mehdiabad. This is due to the fact, noted in Chapter 3, that the percentage of farm area amongst the small farms is greater in Chak than in Mehdiabad. The characteristicsof small farms (suggested by H.1 to H.3) that result in their intensive cultivation practices may then explain the higher village wide returns to land in Chak.

In the two 'barani' villages, higher technical efficiency in Jatli compared to Khunda, given similar returns to land, suggest that the production function in the former lies above that of the latter. Our measure of returns to land indicates the intensity of cultivation. Similarity of the values of this measure in the two villages indicates the similarity in the intensity of cultivation. Comparing the Gini coefficients of land concentration in the two villages (from Table 4.16) we note that land concentration reveals a similar pattern in the two villages. The size-effect on the village-wide production function, therefore, is not very different in Jatli compared to Khunda. Greater technical efficiency in Jatli may then be explained mainly in terms of the greater use of modern inputs such as high yield variety seeds and chemical fertilizer by all farmers in the village compared to farmers in Khunda.

Table 4.16 Gini coefficient of land concentration in the four villages

Villages	Barani		Canal irrigated	
	Khunda	Jatli	Mehdiabad	Chak
Gini coefficient	0.48	0.47	0.59	0.42

In Chapter 2 we discussed empirical studies that assert a positive relationship between size and productivity. The argument is that in areas where 'green revolution' technology is widespread large farms have greater access to new, superior, inputs (such as high yield variety seeds, fertilizers and tube-wells) which raise their yields compared to small farmers. Further evidence for this conclusion is seen in the changes in relative incomes in favour of large farmers as a result of introducing 'green revolution' technology (Griffin (1974)).

We believe that neither the change in relative incomes nor higher yields on some large farms imply a reversal of the inverse size-productivity relationship. It is probably true that some large farms do use more inputs per acre which result in higher yields than those of small farms. However this is not true, generally, for all large farmers. Further, the reversal of the relationship is not a necessary condition for changes in relative incomes in favour of large farmers. Incomes on large farms may have increased both due to the addition in total cultivated area as well as due to greater yields relative to what the large farmers were getting before. Whether the increase in yields is high enough to reverse the overall size-productivity relationship requires more careful empirical verification than that presented in the literature so far. Certainly, in our villages there is no evidence to suggest that the sign of the

the size-productivity relationship has been reversed.

We shall take up this discussion again in Chapter 6 on technology.

Section 4.4 Production Function with three inputs

In the previous section we were concerned with explanations of the greater intensity of land use by the small farms. In Section 4.1 we presented a detailed discussion of the measures of economic efficiency. In the light of that discussion our concern in Section 4.3.1 and 4.3.2 has been with a partial measure of efficiency which is the value of output per unit of an input (in this case land). In agriculture land may be treated as a comprehensive input only in certain special circumstances. For example, we argued in Section 4.2.0 that in a perfectly neo-classical world there would be no need to have any input other than land in the production function. However, we have seen that our village economies are characterized by market imperfections so that for a comprehensive discussion of economic efficiency in our villages we should estimate production functions that include other inputs in addition to land. In the present section we shall estimate production functions with three inputs, i.e. land, draught power and the value of modern inputs such as seeds and fertilizers.

An important aspect of the debate on 'green revolution' technology is the differential access to inputs across farms of different size (see Chapters 2 and 6). The argument here is that small farms have better access to traditional inputs such as the quality of soil and family labour (Section 4.3.2). With the introduction of new inputs, however, access to capital becomes quite important. Here large farms may have an advantage. The results based on the comprehensive measure of economic efficiency that we shall estimate and discuss in this section will be contrasted with the results of Section 4.3.1. This will bring into sharper focus the arguments in the debate on size and productivity.

We shall next report the results for production functions using the three inputs which were discussed in Section 4.2.3.

Production functions are estimated for each size-category in each village, for all farms in each village irrespective of size differences, for each ecological zone and finally for the entire farming population in the four villages taken together.

In Table 4.17 a, we have presented the results for the village level production function in each village. R^2 values for all four villages are quite high for cross-section data. Nearly all of the estimated coefficients have the expected signs and are statistically significant. In Jatli the coefficient on MIUT is insignificantly different from zero. This is probably due to an error in the specification of the production function. We expected high use of MIUT in Jatli because of the presence of a model Integrated Rural Development Project (IRDP) Centre (see Chapter 1). Being situated near Islamabad it is the pride of IRDP centres and is often shown to important Government and other visiting dignitaries. As a consequence, farmers residing in the village have greater access to subsidised inputs such as seeds and fertilizers. Another exceptional result is the negative sign of the coefficient for WAMALVAL in Chak. (However, it has a low significance level.) This may be explained by the choice of WAMALVAL as a proxy for draught power. As argued earlier (Section 4.2.2) the consequence of this proxy variable is to exaggerate the value of services of draught power used in crop production. Therefore, the coefficient is probably underestimated. Thus, we shall have to interpret this result with some caution. The last result to be noted in Table 4.17 a is the computed value of the returns to scale factor [1/] in the four villages. It can be seen that, except in Jatli, the village economies are characterized by constant returns to scale. In Jatli, diminishing returns are probably due to the specification error discussed above.

1/. The test of the statistical significance of constant returns to scale may be incorporated explicitly into the estimation procedure as a restriction on parameters. We have used the alternative approach of adding up the coefficients and then testing whether the sum is significantly different from one. Our procedure is based on a standard result in econometrics (see, e.g., Johnston (1972) pp.166-167 and Searle (1971) p.55)

If $\underline{\theta}$ $(=(\theta_1.....\theta_k)')$ is distributed with mean 0 and has variance covariance matrix Σ, then any homogenous linear combination of the elements of $\underline{\theta}$ say (as in our case) $f(\underline{\theta}) \equiv S = \theta_1+\theta_2+\theta_3$ has mean 0 and variance

$$f'(\theta)' \, \Sigma \, f'(\theta) = \left(\frac{\partial f}{\partial \theta_1}, \frac{\partial f}{\partial \theta_2}, \frac{\partial f}{\partial \theta_3} \right) \Sigma \begin{bmatrix} \frac{\partial f}{\partial \theta_1} \\ \frac{\partial f}{\partial \theta_2} \\ \frac{\partial f}{\partial \theta_3} \end{bmatrix}$$

$$= (1 \quad 1 \quad 1) \begin{bmatrix} \text{var } \theta_1 & \text{cov } \theta_1\theta_2 & \text{cov } \theta_1\theta_2 \\ \text{cov } \theta_2\theta_1 & \text{var } \theta_2 & \text{cov } \theta_2\theta_3 \\ \text{cov } \theta_3\theta_1 & \text{cov } \theta_3\theta_2 & \text{var } \theta_3 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

$$= \text{var } \theta_1 + \text{var } \theta_2 + \text{var } \theta_3 + 2 \text{ cov } \theta_1\theta_2 + 2 \text{ cov } \theta_2\theta_3 + 2 \text{ cov } \theta_1\theta_3$$

Thus from the variance, covariance matrix for the regression reported in Table 4.17 a it is easy to calculate the var of S . We can then test whether the calculated value of S is significantly different from 1.

In Table 4.17 b we have presented marginal products of each of the three inputs in the four villages. It is fairly straightforward to calculate these given that our underlying production function is Cobb-Douglas (see Section 4.2.3). Marginal product of MIUT in Jatli has not been reported because the estimated coefficient value of MIUT is statistically insignificant. Further, the marginal product of WAMALVAL has to be interpreted carefully given our earlier argument that WAMALVAL exaggerates the value of services of bullocks used in the production process. The range of marginal product for land across the four villages is worth noting. (It reflects the rental value of an acre of land in the villages). The exceptionally low value for Khunda is reflective of the poor quality of soil in that region (see Chapter 1). The value of the marginal product for MIUT is indicative of the importance of uncertainty in the calculus of farmers. It may imply that farmers are governed by a decision rule for factor allocation that equates the marginal cost with the value of marginal product times a factor of uncertainty, i.e.

$$M.C = VMP \times \theta \quad (0 < \theta < 1 \text{ is a measure of risk})$$

It is worth noting that our estimates of marginal results are similar in magnitude to those reported by Bliss and Stern (1980) for Palanpur village in India. The value of the estimated marginal product for MIUT is twice as high in Chak compared to Mehdiabad. This is probably due to the lack of tube-well irrigation in Chak. The new inputs used in the irrigated areas respond best to controlled irrigation. Farmers in Chak have access only to canal irrigation while farmers in Mehdiabad have access to both canal as well as tube-well irrigation. With less control over irrigation, cultivation is more risky for farmers in Chak compared to farmers in Mehdiabad. In other words, the value of θ is lower for farmers in Chak, correspondingly the <u>ex-post</u> value of MIUT is higher. It is difficult to compare the marginal product of MIUT for Jatli and Khunda with those of the irrigated villages because of the ecological differences which result in the two villages using very little of the modern inputs (see Section 4.2.2).

Results presented in Table 4.17 a. suggest that at least three of the villages, i.e. Khunda, Mehdiabad and Chak, are characterized by constant returns to scale. (For Jatli we shall have to be agnostic since the production function is probably misspecificed.) This result is to be contrasted with the result (i) of Section 4.3.1 in which we suggested that returns to land diminish as the size of holding increases in all four villages.

We shall next present a discussion where we shall argue that constant returns to scale for a production function with three inputs may exist at the same time as diminishing returns to land indicated by single input production functions. We shall explain this in terms of differences in the intenstities of factor use by farmers in different size-categories. To do so we shall estimate the three input production functions for each size-catergory of farms in all four villages. This will allow us to compute marginal products and then comment on intensity of use. First, we shall present <u>a priori</u> arguments to indicate the anticipated relative intensity of factor use by different farms.

WAMALVAL, with all its measurement problems noted in Section 4.2.2, is our measure of the value of the services of draught power used on the farm. Should we expect large farms to have some inherent ability enabling them to use draught power more intensively compared to the small farms ? The answer, at least on <u>a priori</u> grounds, is ambiguous. We argued in Section 4.2.2 that markets for the services of bullocks are non-existent in our villages. Thus larger farmers' greater access to capital does not enable them to purchase greater bullock services.

But bullock services may be exchanged on the basis of other non-market arrangements (such as social obligation etc.). But this implies that small farmers are likely to have greater access to bullock services since they are more likely to be involved in traditional peasant economic systems which are characterized by non-market exchange arrangements (Sen (1966)). Further, the maintenance of bullocks is a very labour intensive activity since regular feeding of bullocks requires growing fodder crops. Also, in bullock cultivation there is a strong complementarity between bullock and labour use because at least one person is required to operate a pair of bullocks. Thus greater availability of labour on the small farms is likely to result in the greater use of WAMALVAL and hence a lower value for its estimated marginal product.

The other variable in the production function is MIUT, the value of seeds and fertilizer used on the farm. It is easy to see that large farms have better access to these inputs compared to small farms because of the facility in borrowing from Government and commercial institutions (see Chapter 3). Further, returns from applying new varieties of seeds and fertilizer can be improved through greater information about the basic technology. Here also, large farms may have better access due to contacts with Government extension agencies. Access to capital markets and information about the technology is likely to lower the perceived risk of cultivation for large farmers. This may also result in greater application of seeds and fertilizers. On a priori grounds, therefore, it may be argued that large farms are likely to use the new inputs more intensively compared to the small farms. (These issues will be taken up again in detail in Chapter 6.)

Our discussion implies that the addition of WAMALVAL and MIUT in the production function reported in Table 4.17a, is likely to give results that are different from a production function in which land alone is the input. In the latter, small farms have advantages on account of both greater availability of labour and better quality of soil. In the former, WAMALVAL may work to the advantage of small farmers but the coefficient of MIUT is likely to show greater intensity of use on the large farms. If the overall effect is stronger for MIUT , there may be diminishing returns to land when returns to scale are constant. This argument requires empirical verification. To do so, we have estimated the three input production functions for small, medium and large farms in all four villages. The results are reported in Table 4.18 through 4.21.

Our results indicate that in all four villages, for small and large farms the marginal product of WAMALVAL is consistently higher than that for the medium sized farms. Further, we find that the marginal product is consistently and appreciably lower for the small farms as compared to the large farms. On the basis of this evidence we may conclude that small farms use draught power more intensively compared to the large farms. The more interesting conclusion, however, is that the medium sized farms use draught power more intensively than either of the other two categories of farms. This result may be interpreted to suggest that medium sized farms have neither the disadvantages of small farms regarding access to capital markets, nor those of the large farms regarding the availability of human labour required to apply draught power on the farm.

Next, we turn to the discussion of MIUT . In Tables 4.18 and 4.19 we have reported the results for the two 'barani' villages. It can be seen from part 'b' of both tables that the value of the marginal product is higher for the large farms as compared to both medium and small farm categories. This implies that large farms use variable inputs such as seeds and fertilizers less intensively compared to the other two categories.

The results for Mehdiabad (Table 20) and Chak (Table 21) indicate, however, that the value of marginal product of MIUT is lower on large farms, compared to the other two farm categories, which suggests greater intensity of use of seed and fertilizer by the large farms. These results should be viewed in the light of the fact (noted in Section 4.2.2) that Khunda and Jatli are 'barani' villages where the use of fertilizer is not widespread and the use of strains of high yield variety seeds is somewhat limited. On the other hand, both Mehdiabad and Chak villages are from an area that is technologically one of the most advanced districts of Punjab (see Chapter 1). Our results, therefore, appear to support the view that new inputs are likely to be used more intensively by the large farmers because of imperfections both in the capital markets as well as in the Government extension services. This may explain why we observe constant returns to scale along with diminishing returns to land in both Mehdiabad and Chak. (In Chapter 6 we shall discuss the direct evidence on the use of new inputs , and the importance of the size of farm in determining the adoption pattern of 'green revolution'technology.)

In Jatli, diminishing returns to land are likely to be observed along with decreasing returns to scale in a correctly specified production function. In Khunda, the medium size farms use WAMALVAL as well as MIUT more intensively than the other farm categories. It is possible that in Khunda constant returns to scale are observed along with dminishing returns to land due to the concentration of farms in the medium size category.

We may compare returns to land and scale in the two 'barani' villages taken together with the two canal irrigated villages and also comment on results for all villages taken together. If we assume that the two groups of villages enable us to construct zones that are representative of the province, we may generalise our results. From

Table 4.17 a   Estimated elasticities for the three-input production functions   (log-linear form)

Dependent variable : L(TPROD) 1/

Villages Indep.Variables	Khunda	Jatli	Mehdiabad	Chak
L(HOLDCULT)	0.14 (3.06) 2/	0.62 (178.13)	0.36 (16.18)	0.59 (49.62)
L(WAMALVAL)	0.21 (9.69)	0.19 (13.97)	0.45 (18.11)	-0.06 (1.03)
L(MIUT)	0.66 (56.07)	0.01 (0.16)	0.22 (8.90)	0.42 (48.67)
CONSTANT	0.45	2.08	1.34	2.33
R^2	0.60	0.63	0.74	0.77
F	74.72	87.54	55.61	77.71
N	188	159	64	75
Return to Scale 3/	1.01 (0.20)	0.81 (3.71)	1.03 (0.25)	0.95 (0.42)

1/. For a definition of variables, see pp. 145, 146.

2/. Figures in brackets are F-values

3/. See footnote on p. 174.

Table 4.17 b   Estimates of marginal products based on the elasticities given in Table 17 a (above)   (in Rs)

Villages Inputs	Khunda	Jatli	Mehdiabad	Chak
HOLDCULT	11.61	171.78	292.51	360.95
WAMALVAL	0.04	0.111	1.34	-1.04
MIUT	2.69	-	2.43	5.21

Table 4.18 a Estimated elasticities for the three input production function for farms in different size categories in Khunda

Dependent variable : LTPROD 1/ (log-linear form)

Size Categories 3/ / Indep.Variables	Small	Medium	Large	All Farms
L(HOLDCULT)	0.26 (0.84) 2/	0.42 (2.61)	-0.15 (0.55)	0.14 (3.06)
L(WAMALVAL)	0.25 (2.14)	0.19 (2.61)	0.26 (4.41)	0.21 (9.69)
L(MIUT)	0.57 (8.52)	0.48 (15.35)	0.81 (19.61)	0.66 (56.07)
CONSTANT	0.44	0.69	0.35	0.45
R^2	0.53	0.19	0.55	0.60
F	13.00	7.34	19.14	74.72
N	39	97	52	188

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F-values.

3/. Size-categories are defined in Section 4.2.2.

Table 4.18 b Estimates of marginal products based on elasticities given in Table 4.18 a (above) (in Rs)

Size Categories / Inputs	Small	Medium	Large	All Farms
HOLDCULT	-	41.10	-	11.61
WAMALVAL	0.05	0.03	0.07	0.04
MIUT	2.60	0.79	3.85	2.69

Table 4.19 a Estimated elasticities for the three-input production function for farms in different size-categories in Jatli

Dependent variable : L(TPROD) 1/ (log-linear form)

Size Categories 3/ / Indep.Variables	Small	Medium	Large	All Farms
L(HOLDCULT)	0.50	1.45	0.16	0.62
	(36.08) 2/	(13.78)	(0.74)	(178.13)
L(WAMALVAL)	0.15	0.09	0.24	0.19
	(4.53)	(0.53)	(7.07)	(13.97)
L(MIUT)	0.01	-0.07	0.14	0.01
	(0.08)	(1.54)	(3.65)	(0.16)
CONSTANT	2.27	1.87	2.23	2.08
R^2	0.39	0.27	0.39	0.63
F	18.45	5.15	4.25	87.54
N	89	46	24	159

1/. For definition of variables, seepp. 145, 146.

2/. Figures in brackets are F-values.

3/. Size-categories are defined in Section 4.2.2.

Table 4.19 b Estimates of marginal products based on elasticities given in Table 4.19 a (above) (in Rs)

Size Category / Inputs	Small	Medium	Large	All Farms
HOLDCULT	185.45	423.83	-	171.78
WAMALVAL	0.07	-	0.20	0.11
MIUT	-	-0.89	1.48	-

Table 4.20 a Estimated elasticities for the three-input production function for farms in different size-categories in Mehdiabad

Dependent variable : L(TPROD) 1/ (log-linear form)

Size Categories 3/ / Indep.Variables	Small	Medium	Large	All Farms
L(HOLDCULT)	0.53	0.48	0.47	0.36
	(3.48) 2/	(0.98)	(5.41)	(16.18)
L(WAMALVAL)	0.63	-0.19	0.64	0.45
	(11.08)	(1.56)	(11.96)	(18.11)
L(MIUT)	0.24	0.30	0.13	0.22
	(4.53)	(3.41)	(1.00)	(8.90)
CONSTANT	0.55	3.35	0.71	1.34
R^2	0.76	0.35	0.74	0.74
F	13.91	3.50	17.15	55.61
N	17	24	23	64

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F-values.

3/. Size-categories are defined in Section 4.2.2.

Table 4.20 b Estimates of marginal products based on elasticities given in Table 4.20 a (above) (in Rs)

Size Category / Inputs	Small	Medium	Large	All Farms
HOLDCULT	814.29	490.26	336.53	292.51
WAMALVAL	1.49	-0.48	2.12	1.34
MIUT	3.16	3.37	1.39	2.43

Table 4.21 a Estimated elasticities for the three-input production function for farms in different size-categories in Chak

Dependent variable : L(TPROD) 1/ (log-linear form)

Size Categories 3/ / Indep.Variables	Small	Medium	Large	All Farms
L(HOLDCULT)	0.97	0.85	0.37	0.59
	(10.44) 2/	(10.77)	(8.37)	(49.62)
L(WAMALVAL)	-0.16	-0.09	0.44	-0.06
	(1.33)	(1.78)	(9.96)	(1.03)
L(MIUT)	0.73	0.46	0.23	0.42
	(26.67)	(18.67)	(5.04)	(48.67)
CONSTANT	1.83	2.07	1.34	2.33
R^2	0.82	0.57	0.67	0.77
F	13.41	12.47	24.79	77.71
N	13	32	41	75

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F-values.

3/. Size-categories are defined in Section 4.2.2.

Table 4.21 b Estimates of marginal products based on elasticities given in Table 4.21 b (above) (in Rs)

Size Category / Inputs	Small	Medium	Large	All Farms
HOLDCULT	660.49	516.27	226.47	360.95
WAMALVAL	-0.20	-0.09	1.25	-1.04
MIUT	3.75	5.17	2.97	5.21

Table 4.22 a Estimated elasticities for the three-input production function for farms in different size-categories in barani, canal irrigated and in all villages

Dependent variable : L(TPROD) 1/ (log-linear form)

Villages / Indep.Variables	BARANI Villages	CANAL IRRIGATED Villages	ALL VILLAGES
HOLDCULT	0.33	0.50	0.23
	(30.61) 2/	(59.72)	(14.88)
WAMALVAL	0.20	0.09	-0.06
	(9.58)	(2.14)	(1.04)
MIUT	-0.07	0.04	0.48
	(2.31)	(70.31)	(107.06)
CONSTANT	2.20	1.95	2.16
R^2	0.26	0.74	0.34
F	33.47	131.34	82.47
N	290	139	487
Return to Scale	0.46	0.99	0.65
	(21.37)	(0.95)	(45.43)

1/. For definition of variables, see pp. 145, 146.

2/. Figures in brackets are F-values.

Table 4.22 b Estimates of marginal products based on elasticities given in Table 4.22 a (above) (in Rs)

Villages / Inputs	BARANI Villages	CANAL IRRIGATED Villages	ALL VILLAGES
HOLDCULT	23.05	375.13	95.62
WAMALVAL	0.03	0.34	-0.82
MIUT	-0.17	4.54	4.21

Table 4.7 (Section 4.3.1) for a single input production function the returns to land for the three groups are 0.39, 0.89 and 0.52 respectively. From Table 4.22 we can see that for returns to scale, in the corresponding groups, the estimated values are 0.46, 0.99 and 0.65. Given the arguments presented above, we may suggest that in the irrigated areas access to new inputs is easier for the large farmers hence returns to scale are almost constant despite the small farms' more intensive use of land. In the 'barani' areas the concentration of farms in the medium size category improves returns to scale but diminishing returns to land persist along with overall decreasing returns to scale. Similarly, taking all four villages jointly, we have diminishing returns to land along with decreasing returns to scale.

Section 4.5 Conclusions

On the basis of the empirical evidence available in our four villages it may be concluded that small farms have a higher total value of output per acre compared to large farms. Further, the difference in the total value of output per acre between small and large farms is smaller in the irrigated villages compared to the 'barani' villages.

The inverse relationship between size and productivity is due to the higher cropping intensity on the small farms. A number of hypotheses may be suggested to explain this. The important two are that a) due to historical-demographic reasons small farms have a higher proportion of good quality soil and b) due to imperfections in the labour market small farms use family labour more intensively. The first hypothesis is partially confirmed by the evidence that in the canal colony villages that have been settled comparatively recently, and where the demographic process has not worked itself out completely, returns to land are higher than in the two 'barani' districts. We do not have direct evidence on the use of family labour on the small farms. However, small farms are not dependent entirely on family labour ; the use of seasonal labour is widespread. A test of the labour based hypothesis revealed that in none of the villages farms using mainly hired labour are less efficient compared to farms using mainly family labour. In Jatli, labour-hiring farms appear to be more productive, confirming the hypothesis that farms using wage labour are technologically superior to other farms. Thus the labour based explanation for the inverse relationship is not supported by the evidence in our villages. We must add, however, that ours is, at best, an indirect test of the labour based hypothesis. A more direct test would require evidence which shows that the marginal product of labour (measured in standard units of mandays) on small farms is lower than on large farms.

The smaller difference in the value of output per acre between small and large farms in the two irrigated villages compared to the two 'barani' villages partially confirms a variant of the land based hypothesis. The argument here is that small farms have greater access to irrigation, which improves the yields. In the irrigated villages access to irrigation is relatively more even across farm size compared to the 'barani' villages.

Yet another variant of the land based hypothesis suggests that the concentration of small farms on good quality soil is due to sales at times of distress. This resulted in poor quality land being sold to other farmers. The latter emerged, in due course, as large farmers. The process suggests fragmentation of land on the large farms. The evidence from our villages suggests that while fragments per farm are greater on the large farms, fragments per acre are greater on the small farms. Assuming the latter to be more important, correcting for fragmentation in the size-productivity relationship, lowers the value of the land coefficient. We are thus led to a rejection of the distress sales hypothesis.

It appears that share-cropping tenancy is not important in determining the size-productivity relationship. The relationship persists in all four villages even after all the share-cropped farms are excluded from the village farming populations.

Taking small farms alone we find that constant returns to land operate in all villages except Jatli. The small farms are a homogenous group that appear to have access to a combination of special inputs that distinguishes them from the larger farms. The inputs may be better supervision of the farm, or access to better quality land. We must, however, be cautious about the land based hypothesis since soil fertility itself may be a function of how efficiently a farm is run. Further, on the basis of our rather weak evidence we cannot reject, confidently, the importance of the labour based hypothesis.

Our results further suggest the importance of the distribution of land in a village in determining efficiency of land use, through, perhaps, an influence over the access to other complementary inputs. (This issue will be taken up in some detail in Chapter 6.) However, our results appear to refute the assertion that better access to modern inputs by the large farmers has changed the sign of the size-productivity relationship.

Comparing returns to one input, land, with returns to scale using a three input production function, we note that the latter are constant while the former are diminishing in Khunda, Mehdiabad and Chak. We explain this in terms of differences in the intensity of factor use. The three input production function indicates greater useof seeds and fertilizers by large farmers in the irrigated villages. This, in turn, may be explained by better access to capital markets and better information regarding cultivation practices, both of which may lower risks. This is not true in the 'barani' villages where traditional inputs are in use. In these villages, the medium size farmers use seeds and fertilizers more intensively compared to the other categories. Our results further show that draught power is used most intensively by the medium size farmers in all villages. This may be due to the relative ease of access to capital markets for such farmers (which makes the purchase of bullocks easy) compared to the small farmers, and greater availability of labour compared to the large farmers.

In this chapter we have commented on the intensity of factor use by farms in different size-categories by estimating marginal productivities for three input production functions. Differences in input intensities have been explained in terms of differential access to traditional and new inputs. However, we have restricted ourselves to an examination of the use of seeds and fertilizers only. This was done to make cross-village comparisons. In Chapter 6 we shall examine the access to input argument (particularly with respect to inputs associated with the 'green revolution' technology) in detail. In that chapter we shall examine the direct evidence from our villages and from Khanewal on the use of inputs such as fertilizers, tube-well irrigation, canal irrigation and tractor ploughing by farms differentiated by size-categories as well as tenurial status.

APPENDIX TO CHAPTER 4

Table 4.23 a The distribution of land in small, medium and large size-categories by tenurial status in Khunda

(total acreage)

Tenurial Status / Size Category	All Farms	Owner-cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed-rent tenants	Owner-cum-fixed rent tenants
0-8.99	255.15 (42) 1/	46.60 (10)	202.15 (31)	-	6.40 (1)	-
9-21.99	1402.75 (100)	256.90 (20)	1071.57 (76)	-	74.28 (4)	-
22 and above	2658 (52)	1291.10 (13)	891.00 (28)	-	475.90 (11)	-
Total	4315.90 (194)	1594.60 (43)	2164.72 (135)	-	556.58 (16)	-

1/. Figures in brackets are number of farms

Table 4.23 b Mean size of holding by small, medium, large size category and by tenurial status in Khunda

(Means)

Tenurial Status / Size Categories	All Farms	Owner cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed-rent tenants	Owner-cum-fixed rent tenants
0-8.99	6.08 (6) 1/	4.66 (3)	6.52 (9)	-	6.40 (1)	-
9-21.99	14.03 (33)	6.52 (16)	14.10 (50)	-	18.57 (13)	-
22 and above	51 (62)	99.32 (81)	31.82 (41)	-	43.26 (86)	-
Total	22.25	37.08 (37)	16.04 (50)	-	34.86 (13)	-

1/. Figures in brackets are percentage of acreage. In the last row percentages are for distribution of land across tenure.

Table 4.24 a The distribution of land in small, medium and large size-categories by tenurial status in Jatli

(total acreage)

Tenurial Status / Size Category	All Farms	Owner cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed-rent tenants	Owner-cum-fixed rent tenants
0-4.99	233.51 (87) 1/	216.25 (82)	4.00 (1)	-	13.26 (4)	-
5-9.99	296.56 (46)	221.00 (36)	14.31 (2)	-	61.25 (8)	-
10 and above	670.25 (38)	589.25 (31)	-	-	81.00 (7)	-
Total	1200.32 (171)	1026.5 (149)	18.31 (3)	-	155.51 (19)	-

1/. Figures in brackets are numbers of farms.

Table 4.24 b Mean size of holding by small, medium, large size category and by tenurial status in Jatli

(Means)

Tenurial Status / Size Category	All Farms	Owner cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed-rent tenants	Owner-cum-fixed rent tenants
0-4.99	2.68 (20)	2.64 (21)	4.00 (22)	-	3.31 (9)	-
5-9.99	6.45 (25)	6.14 (22)	7.16 (78)	-	7.66 (39)	-
10 and above	17.64 (59)	19.00 (57)	-	-	11.57 (52)	-
Total	7.00	6.89 (86)	6.10 (2)	-	8.19 (13)	

1/. Figures in brackets are percentage of acreage. In the last row percentages are for distribution of land across tenure.

Table 4.25 a The distribution of land in small, medium and large size categories by tenurial status in Mehdiabad

(total acreage)

Tenurial Status / Size Categories	All Farms	Owner cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed-rent tenants	Owner-cum-fixed-rent tenants
0-6.99	78.53 (20) 1/	29.25 (10)	12.66 (2)	12.00 (2)	21.62 (5)	3.00 (1)
7-12.99	281.14 (26)	17.50 (2)	136.39 (12)	110.00 (10)	17.25 (2)	-
Above 13	1143.52 (24)	578.75 (9)	19.00 (1)	195.65 (7)	-	350.12 (7)
Total	1503.19 (70)	625.5 (21)	168.05 (15)	317.65 (19)	38.87 (7)	353.12 (8)

1/. Figures in brackets are number of farmers

Table 4.25 b Mean size of holding by small, medium, large size category and by tenurial status in Mehdiabad

(Means)

Tenurial Status / Size Category	All Farms	Owner cultivators	Pure tenants share-croppers	Owner-cum-share-croppers	Pure fixed rent tenants	Owner-cum-fixed rent tenants
0-6.99	3.93 (5) 1/	2.93 (5)	6.33 (8)	6.00 (4)	4.32 (56)	3.00 (1)
7-12.99	10.81 (19)	8.75 (3)	11.37 (81)	11.00 (35)	8.63 (44)	-
Above 13	47.65 (76)	64.31 (93)	19.00 (11)	27.95 (61)	-	50.02 (99)
Total	21.47	31.28 (42)	11.2 (11)	21.18 (21)	5.56 (3)	44.14 (24)

1/. Figures in brackets are percentage of acreage. In the last row the percentage distribution of acreage is across tenure.

Table 4.26 a The distribution of land in small, medium and large size-categories by tenurial status in Chak

(total acreage)

Tenurial Status / Size Categories	All Farms	Owner culti-vators	Pure tenants share-croppers	Owner -cum-share-croppers	Pure fixed rent tenants	Owner-cum-fixed-rent tenants
0-4.49	97.41 (34) 1/	92.16 (32)	4.00 (1)	1.25 (1)	-	-
5-9.49	246.43 (37)	175.88 (27)	-	5.00 (1)	18.00 (2)	47.55 (7)
9.50 and above	684.24 (39)	407.74 (21)	110.25 (8)	-	75.50 (4)	90.75 (6)
Total	1028.08 (110)	675.70 (80)	114.25 (9)	6.25 (2)	93.50 (6)	138.30 (13)

1/. Figures in brackets are the number of farmers.

Table 4.26 b Mean size of holding by small, medium, large size category and by tenurial status in Chak

(Means)

Tenurial Status / Size Category	All Farms	Owner culti-vators	Pure tenants share-croppers	Owner -cum-share-croppers	Pure fixed rent tenants	Owner-cum-fixed-rent tenants
0-4.49	2.87 (10) 1/	2.88 (14)	4.00 (4)	1.25 (20)	-	-
5-9.49	6.66 (23)	6.51 (26)	-	5.00 (80)	9.00 (19)	6.79 (34)
9.50 and above	17.55 (67)	19.42 (60)	13.78 (12)	-	10.88 (81)	15.13 (66)
Total	9.35	8.48 (66)	12.69 (11)	3.13 (0.6)	15.58 (9)	10.64 (14)

1/. Figures in brackets are percentages of total acreage. In the last row the percentage distribution is across tenure.

CHAPTER 5

Tenancy

Section 5.0 Introduction

In Chapter 2 Section 2.2 it was pointed out that tenancy is an important production arrangement in Pakistani agriculture. The discussion of the theory of tenancy was also presented in that chapter. In this chapter we shall attend to two empirical issues concerning tenancies in our villages. These issues are, efficiency regarding inputs used and output produced on farms with different tenurial arrangements, and the identification of the factors explaining the incidence of tenancy.

The predominant unit of production in our villages is the self-cultivated farm of a landowner who does not rent in additional land. The next most frequently occurring tenurial category is the pure share-cropping tenant, follwed by owner-cum-share-croppers. Another tenancy contract in our villages is fixed-rent tenancy, where rent is determined at the beginning of the cropping season. In the two 'barani' villages this contract does not exist. In the irrigated villages there are two types of fixed-rent tenants; pure fixed-rent tenants who own no land of their own and fixed-rent tenants owning some land, i.e. owner-cum-fixed-rent tenants.

Table 5.1 shows the distribution of tenancies in our four villages and Table 5.2 gives the percentage of area cultivated under different tenurial arrangements. It can be seen that there is considerable variation within villages regarding the distribution of households and land amongst different tenurial categories.

Share-cropping contracts in Pakistan are governed by rules prescribed in official policy. The last tenancy policy came into effect in 1972. It specifies the proportions in which inputs and outputs are shared between the landowner and his share-cropping tenant. The landowner is entirely responsible for the payment of land revenue, water rates, expenditure on seeds and other cesses. The cost of inputs such as fertilizer and pesticides is shared equally by the landowner and the share-cropper. Their respective shares in the produce of land are fixed in the ratio of 40:60. The landowner is forbidden from levying any cess or taking free labour from the share-cropper. In addition, laws governing eviction are specified in order to give greater security of tenure to the tenant (Chaudhry and Herring (1974)).

In practice, however, share-cropping contracts in our villages are governed by a complex variety of informal arrangements between the landowner and his tenants. These arrangements deviate from the legally prescribed terms of the contract. In our villages fertilizer costs and water rates are equally shared between share-cropper and landowners, while seed costs are met entirely by share-croppers. Output is nearly always equally shared between landowners and share-croppers. During the course of our discussion in the sections that follow in this chapter we shall point out other informal arrangements between landlords and tenants that are village specific.

Fixed-rent tenants in our villages are mainly cash rent tenants. The usual practice is for the lessees to pay half the contracted cash rent in advance of the annual cropping season and the other half at the end of the season. There are no government regulations on the rent that a landowner may charge for his land. Landowners do exercise discretion on some occasions when harvest is unusually bad by foregoing part of the amount outstanding at the end of the season. Regarding the duration of the lease, the practice is that the lease lasts over a complete annual cropping season.

Table 5.1 Distribution of households by tenurial categories

(number of farms)

Tenurial Categories / Villages	Pure Owner-Cultivators	Pure Share-croppers	Pure Fixed-cash Cultivators	Owner-cum-tenants (share-croppers)	Owner-cum-tenants (fixed-leasers)	Total
Khunda	43	135	-	16	-	194
Jatli	149	3	-	19	-	171
Mehdiabad	21	15	19	7	8	70
Chak	80	9	2	6	13	110

Table 5.2 Distribution of land by tenurial categories

(percentages)

Tenurial Categories / Villages	Pure Owner-Cultivators	Pure Share-croppers	Pure Fixed-cash Cultivators	Owner-cum-tenants (share-croppers)	Owner-cum-tenants (fixed-leasers)	Total
Khunda	37	50	-	13	-	100
Jatli	86	2	-	13	-	100
Mehdiabad	42	11	21	3	24	100
Chak	66	11	1	9	13	100

The discussion here of the salient features of the market for tenancies in the four villages is brief. Our objective is to provide a general background in which the market for tenancies operates. Data were collected in Khanewal that describe the nature of tenancy contracts in great detail. The discussion based on these data was presented in Chapter 3.

In Section 5.1 we shall examine the issue of relative efficiency of owner-cultivated and share-cropped farms. For some of the villages we shall attempt a more disaggregated crop-level analysis of important crops to ascertain whether overall differences in efficiency are accounted for by specific crops or cropping patterns. This will indicate whether seasonal variations in related factor markets (such as labour) are important in determining the relative efficiency of tenurial contracts. The test for efficiency will be carried out by comparing pure owner-cultivators with pure share-croppers as well as by comparing performance on owned and share-cropped portions of land for owner-cum-share-croppers. Other hypotheses concerning differences in labour inputs, cropping intensity and the choice of cropping patterns will also be tested. The empirical results will be discussed in the light of theoretical predictions. We shall present arguments to suggest that under certain labour market regimes share-cropping farms may, in fact, be more productive than owner-cultivated farms.

Our main concern in Section 5.2 will be with testing a model explaining the incidence of tenancy in our villages. We shall argue that tenancies are contracted as a consequence of attempts by owners of factors to adjust factor ratios to the endowments when markets for factor services are imperfect. We shall identify the main sources of factor market rigidities in the village economies. An attempt will be made to explain the variation in the success with which cultivators adjust their factor ratios in our four villages. The impact of tractor cultivation and rural-urban migration opportunities on the adjustment process will be discussed in the concluding Section 5.3.

Section 5.1 Efficiency comparisons between tenurial contracts

Section 5.1.1 Criteria for comparisons

In this section we present a discussion of the criteria we shall use for testing the differences amongst alternative tenurial arrangements. Our main concern is with a comparison of the efficiency of resource use between owner-cultivators and share-cropping tenants.

We shall first summarise the a priori arguments discussed in detail in Chapter 2. We saw that there are three main arguments in the controversy on the efficiency of share-cropping tenancy. The first argument is Marshallian in spirit. It is argued that share-cropping tenancy results in a disincentive to the cultivator, so that the allocation of variable inputs on the share-cropped farm is inefficient compared to the owner-cultivated farm whenever the landowner is unable to exercise strict supervision.

The second line of argument is derived from Cheung (1969), (but is implicit in Marshall's argument - see Chapter 2 Section 2.2)). It is recognised that in labour surplus economies with land scarcity, landowners have a superior bargaining power in tenancy markets. This enables them to ration land amongst the tenants and to prescribe the quantities of variable inputs (such as labour) to be used on the rented land. In this manner they can ensure that share-cropped land is cultivated as efficiently as owner-cultivated land.

The third argument asserts (Johnson (1950), Bliss and Stern (1980)) that most share-cropping contracts involve cost-sharing. We have seen in Chapter 2 that under cost-sharing arrangements, the disincentive argument regarding share-croppers' use of variable inputs no longer holds, so that share-croppers in this regard are as efficient as owner-cultivators.

There are no *a priori* grounds for choosing any of the three arguments presented above as the single correct description of tenancy markets in our four villages. In discussions with cultivators in the four villages the general impression we get is that the landowner exercises considerable discretion in renting out land to tenants. This is particularly true in Mehdiabad and Chak and to a lesser extent in Khunda. In Jatli the situation is somewhat different. There is a long tradition in this village of household members joining Government services such as the police and the military. The policy of recruiting soldiers in this region was started in the British colonial period to reduce pressure on land. Later it became a tradition enshrined in the lofty label of 'martial race'. Because of this outlet there are no pure share-cropping tenants in Jatli. Land is rented on share-cropping contracts only by those households who already own land in the village .

The tradition of joining the police and the military services prevails to some extent in Khunda as well which is situated on the periphery of the 'martial race' region. For a description of landowners' bargaining power in Mehdiabad and Chak, we may refer to our discussion of Chapter 2 on the nature of contracts in Khanewal. We have argued that this discussion is relevant since there are many similarities, both institutional and ecological, between the villages in Khanewal and Chak and Mehdiabad.

The extent of supervision varies considerably amongst landowners within the villages. Small landowners who live in the village supervise land closely. The standard practice for small and medium size landowners with commercial interests outside the village is to pay one weekly visit to the plot. It is difficult to decide which of the two methods of supervision is better. The former method leads to 'excessive' supervision and often results in tension between the landowner and his share-cropping tenant. But it results in the landlord having a very good knowledge of the 'norms' of agricultural activities such as ploughing, irrigating and hoeing. Landowners with commercial interests outside the village forego some of the detailed knowledge of cultivation 'norms' but generally appear to be better acquainted with the new technological innovations such as new high yield variety seeds, fertilizers and pest control. This is because their commercial interests bring them in close proximity to the various Government agricultural extension services that are located in small rural towns. Thus they are better placed to encourage and exhort their share-cropping tenants to use new innovations and thus attain yields comparable to share-croppers who are more closely supervised by their landowners in the day-to-day cultivation of the plot.

Supervision is most lax when it comes to the large landowners. The standard practice is for the landowners to visit the plot once a month or occasionally once every crop season. Most of the transaction between landowners and tenants is conducted by the 'munshis' (bailiffs). In theory it is possible for landowners to hire efficient 'munshis' with considerable managerial skills so that supervision on their share-cropped plot is as efficient as that of the small landowners. We got the impression, however, that in practice 'munshis' are retained by most big landowners not so much for their managerial skills as for long-standing loyalties - often the criterion seemed to be sheer sychophancy. In Chapter 3 we have presented a more detailed discussion of the supervision practices of landowners using data from Khanewal. Villages Chak and Mehdiabad in this chapter reflect the situation in Khanewal fairly closely.

We said in Section 5.0 that cost-sharing is far from complete in our four villages. The practice is for the water and fertilizer costs to be shared in the same proportion as the share of output. Seed costs (which are a substantial component of costs especially in Khunda) are paid entirely by the share-cropper. A detailed discussion of the cost-sharing arrangements, which carries over for the canal irrigated villages, was also presented in Chapter 3 using data from Khanewal.

Our discussion, so far, suggests that we cannot choose between Marshallian and Cheungian theoretical positions on the efficiency of share-cropping tenancy merely by observing the conditions of the contract in our villages. Formal tests are required to determine relative efficiency of owner-cultivators and share-croppers. This needs a discussion of criteria that we shall use to test relative efficiency.

Value of output

We shall start our analysis by using total value of output per acre as a measure of efficiency. This is a good summary statistic in that it captures the pattern of allocative decisions of the different types of cultivators. Thus if the value of total output is higher on owner-cultivated farms as compared to share-cropped farms in any given village we shall argue that the share-cropped farms in the village are characterized by the Marshallian disincentive effect. Otherwise the Cheungian position holds.

We shall disagreggate efficiency measured in terms of yields further into the component crops. This will be done for some of the villages for selected crops that are important in the cropping pattern. Output per acre of such crops on owner-cultivated farms will be compared with share-cropped farms.

Input use

Fertilizer :

A direct test of the incentive effect that may cause differences in the efficiency of various tenurial arrangements, is to consider input use per acre on the farms. The application of fertilizer per acre is ideally suited to capture the disincentive effect of input use when costs are not shared between landlords and tenants. In our four villages fertilizer costs are nearly always shared. However, within each village there is considerable variation amongst landowners regarding the timing of payment of their share of the cost. Some landowners pay their share of costs at the time of harvest (by converting it into equivalent'maunds'of crop output). Other landowners share cost at the time of purchase of fertilizer. Still others purchase fertilizer themselves and deduct the share-cropper's share of the cost at harvest time from the total crop produce.

All the cost-sharing arrangements discussed above can be observerd in our four villages. But we were unable to get detailed information to quantify the number of each type of arrangement in any of the four villages. We suspect, however, that the disincentive effect due to the timing of cost-sharing is small in our villages since fertilizer is usually applied at the landowner's insistence. (For the practice in Khanewal, see Chapter 3). He is, therefore, prepared to extend credit to the share-croppers (or, as in many cases, actually purchases fertilizer himself) in order to ensure its application [1/]. Supervision at the time of fertilizer application is generally considered to be an important element in the overall supervision of the share-cropped farm. We expect that on account of both these factors fertilizer use is no different on share-cropped farms as compared to owner-cultivated farms.

Cultivator-land ratio

The theory of share-cropping tenancy suggests that landowners find this tenurial contract attractive because of imperfections in the labour market that result in the wage rate being greater than the opportunity cost

---

1/. It is possible that access to liquidity may affect the chances of a tenant getting land on rent. This point will be taken up again in Chapter 7.

of labour. This discourages self-cultivation with hired labour (see the discussion in Section 2.2, Chapter 2). Another attraction could be due to the high search costs of finding the right type of farm worker for the required farm activity. As a result of share-cropping tenancy landowners can ensure a regular, certain flow of labour services whose quality is known to the landowners. This comes about because in a labour surplus economy landowners can ration land and thus select the 'best' share-croppers. Share-cropping tenancy contracts, therefore, may be interpreted as an institutional arrangement whereby a landowner, owning land in excess of what he can cultivate with his own labour resources, ensures the appropriate supply of labour and thus achieves the correct land-labour ratio on the farm. This suggests that given constant returns to scale, labour input per acre on self-cultivated and share-cropped farms would be the same.

Tractor cultivation is on the increase in both 'barani' as well as irrigated villages (see Section 5.3). This is primarily due to the increased cropping intensity that becomes possible with tractor cultivation (Binswanger (1977)). Increased tractor cultivation is likely to affect the share-cropping contract particularly as an institution for ensuring appropriate supply of labour on the farm. Let us reconsider the form of tractorization that is taking place in our villages. Tractor cultivation is practised by both large as well as small cultivating households because of the development of active markets for the services of tractors. Cultivation with hired tractors requires cash outlays before the crop is harvested which implies borrowing in the rural credit market. (This is particularly true for small farmers. Large farmers may hire tractors by reducing their cash balances rather than borrowing in the credit market.) The self-cultivating landowners may find it easy to borrow because of their ability to pledge their land as collateral.

Share-cropping tenants, on the other hand, can borrow only if the landowners are prepared to pledge land on their behalf or if landowners provide the necessary credit for hiring tractors. Both these options may be unattractive to landowners. Pledging land on behalf of share-croppers so that they may borrow from Government credit institutions, may provide proof of the existence of a share-cropping contract. This may be considered by landowners as detrimental to their interests. (Given an environment of tenancy reforms, this may result in a transfer of ownerhsip rights to the share-cropper.) Lending cash to the share-cropper may be unattractive if landowners have other non-farming commercial interests with high rates of return that do not allow the holding of idle cash balances for long periods of time. Under these circumstances share-croppers may be unable to borrow cash in order to meet the cost of hiring tractors. This may lower cropping intensities and thus the total value of output on share-cropped farms as compared to owner-cultivated farms Given this (and also unchanged output shares) landowners may insist on contracts requiring higher labour inputs on the share-cropped plot in order to equate the cropping intensity with owner-cultivated farms that use tractors for cultivation. A viable method of ensuring 'appropriate' labour input is to stipulate the number of workers per acre. We expect that under the circumstances described above landowners are likely to insist (and given scarcity of land due to a growing rural population of tenants they will get) higher cultivator-land ratio on the share-cropped plots as compared to the cultivator-land ratio on owner-cultivated farms. We shall formally test this hypothesis using data from our villages.

Values of livestock :

Farming in our four villages is described by agronomists as 'mixed farming'. This implies that farms do not specialise in any one crop or any other single agricultural produce such as dairy and livestock. Most crops suited to the ecology of the region are grown on the farm along with fodder for livestock bred for draught power, milk and meat. An interesting feature of breeding livestock on share-cropped farms is that the value of livestock is not shared with the landowner. Occasionally, the landowner may leave his own livestock (usually milch animals) on the share-cropped farm to be looked after by the tenant, (and thus may ensure appropriate sharing of fodder crops or other cereal crops with a large fodder content). But this happens rarely, particularly if the landowner lives at a distance from the farm, since that may result in neglect of the landowner's livestock or pilferage of milk by the share-cropper. It was frequently noted during the survey that tension between landowners and tenants arises on account of the latter's desire to cultivate more area of the farm with fodder crops (or at least those crops with a greater fodder content) while the former wanted more area for cash crops. It appears that the share-cropper has an incentive to allocate more resources to growing crops whose output is not shared equally with the landowner. To the extent that value added on the farm on account of livestock production is not shared equally with the land-owner, the cropping pattern on share-cropped farms is likely to favour livestock production. In our formal statistical test of this hypothesis we shall use the final output - total value of livestock per acre on the farm - as a summary statistic reflecting resource allocations that influence the choice of the cropping pattern on the farm 1/ .

1/. It may be noted that cropping patterns do not allow distinction of plots on the basis of suitability of fodder or cash crops. Fodder crops are usually planted between other crops in a fairly sophisticated pattern of crop rotation to avoid the depletion of nitrogenous content of the soil. If plots were to be distinguished, fixed-rent tenancies may be preferred by landowners on plots that are suited for growing fodder.

Another reason for expecting higher value of livestock on share-cropped farms is that an essential asset for the 'marketability' of a tenant is the possession of a strong bullock and other draught animals. Assuming that the birth of a bull has a probability which is equal to that of the birth of a cow, share-croppers may be forced to maintain a larger total value of livestock - in order to have a larger stock of draught animals - compared to owner-cultivators, to ensure their continued marketability as share-cropping tenants.

To summarise, our criterion variables for testing the hypotheses discussed so far are :

1. Total value of output per acre
2. Output per acre for selected crops.
3. Fertilizer use per acre.
4. Adult males working on the farm per acre.
5. Value of livestock per acre.

Section 5.1.2 Test statistics

We shall briefly discuss the statistics that we shall use to test for significant differences between different tenurial arrangements on the basis of criteria discussed in the previous section.

For evaluating the relative efficiency of farmers on the basis of total value of output per acre we shall use regression analysis. Our equation to be estimated is :

$$\text{LTPROD} = \log A + a_1\text{LHOLDCULT} + a_2\text{DTEN} \qquad (1)$$

where LTPROD = log of total value of output produced on the farm

LHLDCULT = log of size of holding measured in acres.

log A : constant

DTEN : dummy for tenancy which takes the value 1 for a share-cropper, 0 otherwise. (Thus the influence of pure share-cropping tenancy is being considered here. See the discussion below on data.)

For the remaining criterion variables there are two ways of testing for differences between self-cultivating landowners and share-croppers. One is to test for significant differences in the criterion variables by comparing farmers who do not share-crop at all (i.e. pure owner-cultivator farmers) with those farmers who are purely share-cropping tenants. For each of the criterion variables we shall test whether the differences in the means of the two types of farmers are statistically significant. We shall assume that the observations on the two groups of farmers have been selected from their respective normally distributed populations. Given this assumption, our choice of the test statistic will be determined by a test that indicates whether the variances of the two normally distributed populations from which the two samples of observations have been drawn are the same. The appropriate test-statistic

$$S = \frac{\Sigma (Y_{1i} - \overline{Y}_1)}{M_1 - 1} \Bigg/ \frac{\Sigma (Y_{2i} - \overline{Y}_2)}{M_2 - 1}$$

where Y_{1i} is the criterion variable observation for individual i in Group 1.

Y_{2i} is the criterion variable observation for individual i in Group 2.

$\overline{Y}_1$ and $\overline{Y}_2$ are the respective sample means of the two Groups.

M_1 and M_2 are the number of observations in Groups 1 and 2.

The statistic S has an F distribution with M_1-1 and M_2-1 degrees of freedom. The samples are defined so that the ratio S is greater than unity (Bliss and Stern (1980)).

If S indicates that there is no significant difference between the variances of the observations for the two Groups, the statistic that we shall use to test for differences in the means of the two Groups is :

$$R = \frac{\overline{Y}_1 - \overline{Y}_2}{W}$$

where $$W^2 = \frac{1}{M_1} + \frac{1}{M_2} \left[\frac{\Sigma (Y_{1i} - \overline{Y}_1)^2 + \Sigma (Y_{2i} - \overline{Y}_2)}{M_1 + M_2 - 2} \right]$$

R has a t distribution with $M_1 + M_2 - 2$ degrees of freedom (Bliss and Stern (1980)).

If, however, variances of the two populations are significantly different the test statistic we shall use is :

$$V = \frac{(\overline{Y}_1 - \overline{Y}_2) - (\mu_1 - \mu_2)}{S^2_{1}/M_1 + S^2_{2}/M_2}$$

where $\overline{Y}_1$, $\overline{Y}_2$ are sample means,

S_1^2 , S_2^2 are the sample variances,

and μ_1 and μ_2 are the population means.

V does not have a t distribution. However probabilities for the statistic may be approximated by treating its distribution as a t-distribution and by calculating the degrees of freedom as :

$$d.f. = \frac{\left[(S^2_{1}/M_1) + (S^2_{2}/M_2) \right]}{(S^2_{1}/M_1)^2/M_2 + (S_2^2/M_2)^2/M_2 - 1}$$ (H.G. Blalock (1972))

An alternative method of testing for differences between self-cultivating and share-cropping arrangements is to consider only those households that are self-cultivating landowners as well as share-cropping tenants (i.e. owner-cum-share-cropping tenants) and compare the values of criterion variables on their self-cultivated and share-cropped plots of land. It has been argued (Bliss and Stern (1980), Bell (1977)) that this method is more suitable for testing Marshallian versus Cheungian positions on the disincentives of share-cropping since we can control for all other differences between individuals who self-cultivate and those who share-crop. The appropriate test statistic here is :

$$Z = \frac{\bar{x}}{S/\sqrt{n}}$$

where $x = Y_1 - Y_2$; $\bar{x} = \frac{Y_1 - Y_2}{n}$; $S^2 = \sum_i (x_i - \bar{x}) / n - 1$,

n is the number of observations,

and S^2 is the variance.

Z has a t distribution with $n - 1$ degrees of freedom (Bliss and Stern (1980)).

The null hypothesis for each of the criterion variables is that there is no significant differerence between the means of the two Groups.

For most of the criterion variables that we shall discuss the theory is unambiguous about the direction of the difference between the means of the two Groups. This suggests that one-tail tests are required. However, we shall be agnostic and use two-tail tests for accepting or rejecting the hypotheses. This will allow us to test whether share-croppers have lower yields than owner-cultivators, and vice versa. Our criterion for rejecting a null hypothesis will be to consider the two-tail probability of the hypothesis being true. If it is less than 5% we shall reject the null hypothesis.

Section 5.1.3 Data

Table 5.1 of Section 5.0 presents the distribution of cultivating households according to the different tenurial categories in the four villages. This distribution will form the basis for selecting villages for making comparisons between owner-cultivators and share-croppers on the basis of the criteria listed in Section 5.1.1.

We have argued that one approach that we shall adopt for testing differences in efficiency is to use a dummy for share-cropping tenancy in a regression equation where total value of output is the dependent variable. Table 5.1 shows that using the dummy variable approach will imply including owner-cum-tenants also amongst the owners. But this is likely to introduce biases while testing for tenurial efficiency [1/]. In our regression analysis, therefore, we shall exclude tenurial categories other than pure owners and pure share-croppers. Another feature to note for regression analysis is that in Jatli there are only 3 pure share-croppers. It does not make much sense to use a dummy for share-croppers in this village. We, therefore, do not report regression results for this village.

A consequence of using equation (1) is that the logarithmic form does not allow us to use observations that take zero value for the two variables in the equation. (We have already discussed in Chapter 4,

---

1/. If share-croppers are inefficient then the inclusion of owner-cum-tenants amongst owners will imply that to the extent output is lower due to share-cropped plots of owner-cum-tenants, their inclusion lowers the value of the estimated coefficient for owners.

Section 4.2, why we may expect some farmers to have positive values for variable HOLDCULT and zero value for TPROD.) Given this and the fact that we are using pure owners and pure share-croppers in the regression analysis, the number of observations in each village for estimating equation (1) are reduced further.

In the previous section we argued that we shall use two approaches in testing for differences between owner-cultivated and share-cropped plots. One is to compare pure owners with pure share-croppers and the other is to compare efficiency on owned and share-cropped land for the same farmer (i.e. owner-cum-share-croppers). In order to use either method we need enough observations in each village to fulfil basic requirements of degrees of freedom for the statistical tests. Table 5.1 indicates that for comparing pure owner-cultivators and pure share-croppers Khunda is the most appropriate village. The number of observations for the two tenurial categories in the village are 135 and 73 respectively. Mehdiabad is the next 'best' village. In the other two villages, the number of observations are insufficient. We shall, therefore, use Khunda (representing 'barani' villages) and Mehdiabad (representing irrigated villages) to test our hypotheses concerning differences in efficiency between owner-cultivators and share-croppers.

For a comparison of relative efficiency on owned <u>and</u> share-cropped land for the same farmer, column 3 of Table 5.1 indicates that only Jatli and Khunda villages provide sufficient observations. This is unfortunate since both are 'barani' villages. It would have been more reassuring to have made efficiency comparisons in the irrigated villages as well.

There are two additional categories in Table 5.1. These are tenants who are pure fixed rent leasers of land and owner-cum-tenants whose rented portion is on fixed rent lease. Theory predicts that we should not expect any differences in efficiency between such tenancies and self-cultivation of landowners. We shall test this accepted result using data from Mehdiabad.

In our discussion of the regression results that will be reported in Table 5.5, Section 5.1.5, we shall argue that in Khunda we need to compare intensity of cultivation on owner-cultivated land with that of share-cropped land. Further, we shall compare the per acre outputs of these two categories of farmers for two crops: wheat and groundnuts - the former being the major 'rabi' crop while the latter is the major 'kharif' crop in Khunda. This will help us to comment on differences in efficiency by crop seasons on different categories of farms.

The other village for which we have sufficient data for pure share-croppers and owner-cultivators is Mehdiabad. In this village we shall compare the mean value of output per acre and fertilizer use per acre on wheat for the two categories of farmers. We are constrained to a comparison of fertilizer use in Mehdiabad only because in Khunda fertilizer use is limited to a few large farmers (see Section 4.2, Chapter 4).

A comparison of adult males per acre on owner-cultivated and share-cropped farms will be made in Khunda and Mehdiabad only for reasons already discussed. The per acre value of livestock on the two tenurial categories will also be compared for these two villages.

The comparison of mean output yields on owner-cum-share-cropped farms will be carried out in Khunda and Jatli. We have not tested for differences in input use on farms because during interviews it became increasingly clear (as reported by the research team at Quaid-e-Azam University) that the reliability of data on input use reported separately for own and share-cropped lands is doubtful. There was much guesswork and approximation involved on the part of both the interviewers as well as the farmers. Therefore, data collection on input use on the two separate plots was discontinued.

Finally, the comparison of owner-farmers and fixed-rent tenants will be restricted to the mean values of total output for farmers in Mehdiabad only.

In Table 5.3 we summarise the criterion variables, the tenurial categories selected for making comparisons and the villages in which comparisons will be made.

Table 5.3 Criterion variables, tenurial categories and villages for making efficiency comparisons

Criterion variables	Tenurial categories	Villages
1. Total value of output per acre	(i) Owner-cultivators with share-croppers	Khunda, Mehdiabad Chak
	(ii) Owner-cum-share-croppers	Khunda, Jatli
	(iii) Owner-cultivators with fixed-lease tenants	Mehdiabad
2. Intensity of cultivation	Owner-cultivators with share-croppers	Khunda
3. Main Rabi crop (wheat) output per acre	"	Khunda
4. Main Kharif crop (groundnuts) output per acre	"	Khunda
5. Fertilizer use per acre	"	Mehdiabad
6. Adult males per acre on the farm	"	Khunda, Mehdiabad
7. Value of livestock per acre	"	Khunda, Mehdiabad

Section 5.1.4 Results

In Table 5.4 we present the results of a regression analysis that seeks to establish the relative efficiency of owner-cultivators and share-croppers. The theory suggests that we should expect the value of the coefficient on DTEN to be either insignificant (à la Cheung) or significantly negative (à la Marshall). This would imply, respectively, that share-cropping tenants are as efficient as owner-cultivators or that share-croppers are less efficient.

In Chak, the value of DTEN is 0.09 and its F-value indicates that it is statistically insignificant. Thus in Chak share-croppers are as efficient as owner-cultivators. In Mehdiabad the F-value is 3.98 which is significant. In Khunda, however, the F-value is rather high. In both villages the coefficient of DTEN is positive suggesting that share-cropping tenants are more efficient than owner-cultivators. This suggests a result contrary to theoretical predictions and needs an explanation.

In our villages, landowners have strong bargaining power in the market for tenancy. This is likely to be exercised mainly in the choice of share-croppers and in stipulating the desired labour input on the farm. Another feature that adds to the landowners' monopoly power is the prevalance of uncertainty in the rural labour market due to the limited employment opportunities for the landless. It is possible, therefore, that landowners dictate greater labour input on share-cropped land as compared to owner-cultivated land. An indirect measure of labour input is the intensity of cultivation. In Table 5.5 we present results of a T-test on the difference in the cropping intensity (defined as cropped area as a percentage of the size of holding) on owner-cultivated and share-cropped farms.

Table 5.4 Regression results for a test of tenurial efficiency

Dependent variable : LTPROD 1/

DEPENDENT VARIABLES	Khunda	Mehdiabad	Chak
LHLDCULT	0.64 (87.05) 2/	0.72 (58.19)	0.88 (171.31)
DTEN	0.18 (11.07)	0.19 (3.98)	0.09 (1.27)
CONSTANT	2.18	3.15	2.89
R^2	0.35	0.64	0.71
F	45.38	31.69	94.22
N	173	38	82

1/. For definition of variables, see pp.206, 207.

2/. Figures in brackets are F-values.

Table 5.5 T-test for differences in mean cropping intensity of owner-cultivators and share-croppers in Khunda

	No. of Cases	Mean cropping intensity	Standard Deviation	T-Value	2-tail probability
Owner-cultivators	42	129.78	113.34	1.86	0.07
Share-croppers	131	96.52	43.73		

(F-value of test for differences in population variance is 6.72 which indicates significant difference. The reported T-value, therefore, is an estimate when variances are unequal.)

The 2-tail probability in the table is 7% which is higher than the conventional significance level of 5% and thus we accept the hypothesis that there is no difference in the mean cropping intensities of owner-cultivators and share-croppers. Our hypothesis that suggests that landowners' bargaining power enables them to get higher intensity of cultivation on share-cropped farms appears to have been rejected. But let us consider the argument in detail.

It has been argued by Khusro (1964) that larger holdings are divided up into small holdings and rented out by landowners to take advantage of higher productivity on small farms. Our discussion in Chapter 4 identifies the sources of higher productivity on small farms. These are summed up in greater intensity of cultivation due to essentially two factors : better quality soil (Sen (1964)), and greater labour effort (Sen (1964), Srinivasan (1972), on small farms. In Khunda the average size of a share-cropped farm is 16.04 acres while the average size of an owner-cultivated farm is 37.97 acres. However, we have seen in Table 5.5 that intensity of cultivation is not significantly different on the two types of farms. In what sense, then, do share-cropped farms reflect higher productivity on account of the size factor ? Higher cropping intensity implies greater farm area under crops. However, in villages such as Khunda, the soil is of poor quality and does not allow much addition to the cropped area. But any given cropped area can yield more output per acre if greater effort is made on it. This effort translates in terms of agricultural activities such as deeper ploughing, greater weeding and hoeing, etc. It may be argued that it is due to higher effort per acre that small farmers in Khunda are more productive than large farmers. We have seen that, on average, share-cropped farms are nearly half the size of owner-cultivated farms. Therefore, part of the higher productivity on share-cropped farms in Khunda may be explained by the size- effect.

Another reason for expecting greater labour effort on share-cropped farms as compared to owner-cultivated farms has already been discussed in Section 5.1.1. We argued that concentration in the land market is likely to result in higher stipulated labour input per acre. We also saw that it is not supported by a test on differences in the intensities of cultivation on the two categories of farms. However, this ought not to be construed as evidence of landowners' limited bargaining power, since that may be exercised through stiputation of higher labour per cropped acre on share-cropped farms as compared to owner-cultivated farms.

The other component of the size-effect, better quality of soil on small farms, is more difficult to verify. In discussions with farmers our impression was that there is little difference in the quality of soil between owner-cultivated and share-cropped farms. (For a discussion on this aspect see Section 3.2 Chapter 3, based on our Khanewal survey.) Thus higher productivity on share-cropped farms in Khunda may be explained mainly by greater labour effort on such farms due to (a) size effect, (b) landowners' bargaining power in the land market and (c) as argued earlier, extension of credit by landowners to their tenants that may increase access to new inputs on share-cropped farms as opposed to other small owner-cultivated farms, and thus may increase productivity.

This result has an important implication for the theory of share-cropping tenancy. Neither Marshallian nor Cheungian theoretical traditions allow for this result. This may be due to the assumption regarding the labour market in the two traditions. Marshallian tradition assumes competition in both land and labour markets (Bardhan and Srinivasan (1971)). The Cheungian tradition allows for landowners' strong bargaining power in the land market but maintains competition in the labour market. This acts as a constraint on the landowner so that he cannot demand greater labour effort than that supplied by owner-cultivators on their own farms.

This is due to the assumption that the opportunity cost of labour is the same for owner-cultivators' labour effort as thatfor share-croppers'. It is plausible to argue (on the basis of our observationson the working of the village labour markets) that owner-cultivators have a higher expected wage rate due to their ability to sustain themselves during the period of job search. For landless share-croppers the cost for job search is likely to be considerably higher so that the expected wage rate is likely to be lower [1/]. This enables the landowner to stipulate greater labour (measured in time units or effort) on the share-cropped land.

We disaggregated the results presented in Table 5.6 by crop seasons to pinpoint the source of higher productivity on share-cropped lands. Results for differences in the two most important crops, wheat and groundnuts, are presented in Table 5.6 for Khunda. The results suggest that differences in total output per acre between owner-cultivators and share-croppers are mainly due to differences in output per acre for groundnuts. Share-cropped farms have a very high mean yield of groundnuts which is significantly different from the mean yields of owners at 5% level of significance. (For wheat, we reject the hypothesis of significant difference between the mean yields on owner-cultivated and share-cropped farms.)

This result has an interesting implication in the context of our argument regarding landowner's strong bargaining power that enables him

---

1/. This argument will be developed further in Chapter 7. To anticipate, it will be argued that the incidence of rural-urban migration is lower amongst share-croppers compared to owner-cultivators because they have husbandry skills that encourage them to stay in the rural areas. Their expected wages, therefore, are determined in the rural labour market, while those of the owner-cultivators are determined in the urban labour markets where wages are higher, particularly in the slack agricultural season.

Table 5.6 T-tests for differences in the mean value of output per acre by crop seasons on owner-cultivated and share-cropped farms in Khunda

	No. of Cases	Mean	Standard Deviation	F-Value	T-Value	2-tail probability
WHEAT						
Owners	42	3.70	1.76	2.54	-0.15*	0.88
Share-croppers	131	3.76	2.81			
GROUNDNUTS						
Owners	28	1.28	3.60	4.88	-5.79*	0.001
Share-croppers	51	8.84	7.95			

* Indicates that T-value has been computed when the population variance is not the same for the two groups.

to stipulate higher labour effort on share-cropped plots. We argued that the bargaining power is greater when the expected wage rate is low for share-croppers. In the slack season ('kharif' employment opportunities in 'barani' areas are particularly low. Groundnut season corresponds with sharecroppers' low expected wages. This enables the landowner to stipulate higher labour effort resulting in higher output per acre on share-cropped farms as compared to owner-cultivated farms. Thus,it appears that there may be seasonal variations in landowners' bargaining power in the land market which are reflected in the relative efficiency of owner-cultivated and share-cropped farms.

For Mehdiabad we report results for output per acre and fertilizer use per acre for wheat in Table 5.7. We find no significant difference between share-croppers and owner-cultivators for the mean values of the two criterion variables.

In Table 5.8 we present results that enable us to test our hypothesis on higher stipulation of labour on share-cropped land in terms of the number of workers per acre in order to compensate for the lack of share-croppers' ability to hire tractors. We find that in Khunda, share-cropper families have, on average, greater number of adult males engaged on the farm as compared to owner-cultivators. This difference is significant at 5% level of significance. In Mehdiabad, the difference in ADMCULT on the two types of farms is statistically insignificant.

Our hypothesis that suggests higher value of livestock on share-cropped farms as compared to owner-cultivated farms due to non-sharing of the annual value of livestock is accepted in Khunda but rejected in Mehdiabad (Table 5.9). An explanation for this is that in Mehdiabad landowners insist on selling the fodder crop and sharing the revenue (In the irrigated areas, fodder crop fetches high prices.) Further the

Table 5.7 T-test for differences in the mean values of wheat output per acre and fertilizer use per acre on owner-cultivated and share-cropped farms in Mehdiabad

	No. of Cases	Mean	Standard Deviation	F-Value	T-Value	2-tail Probab-ility
WHEAT output per acre						
Owners	21	27.00	8.02	1.05	1.16	0.25
Share-croppers	15	23.94	7.81			
FERTILIZER use per acre						
Owners	21	1.29	0.84	2.94	0.40	0.69
Share-croppers	15	1.20	0.49			

Table 5.8 T-tests for differences in the mean value of adult males per acre on owner-cultivated and share-cropped farms in Khunda and Mehdiabad

	No. of Cases	Mean	Standard Deviation	F-Value	T-Value	2-tail probability
KHUNDA						
Owners	73	0.05	0.11	5.01	-4.13*	0.001
Share-croppers	135	0.15	0.25			
MEHDIABAD						
Owners	21	0.33	0.47	5.79	0.40*	0.69
Share-croppers	15	0.28	0.19			

* implies T-value is computed when Group variances are unequal.

Table 5.9 T-tests for differences in the mean value of livestock per acre on owner-cultivated and share-cropped farms in Khunda and Mehdiabad

	No. of Cases	Mean	Standard Deviation	F-Value	T-Value	2-tail probability
KHUNDA						
Owners	73	286.18	361.55	8.13	-3.23*	0.001
Share-croppers	135	608.21	1030.49			
MEHDIABAD						
Owners	21	1490.52	2769.88	0.01	0.80	0.43
Share-croppers	15	1057.35	1489.16			

* implies T-value is computed when Group variances are unequal

crop is sown between the two main crop seasons to enrich the soil with its nitrogenous content. (The aim is to achieve nitrogen fixation. Fodder is rarely ploughed into the soil.) Thus its planting and harvesting is part of landowners' supervision. However, in Khunda livestock feed mainly on grass that sprouts on the farm after the winter and summer rains. The other components of feed are farm wastes. Both are hard to quantify and thus hard to share. The share-cropper has the advantage of greater knowledge of such 'waste'. Landowners may even encourage greater size of sharecroppers' livestock in Khunda for the benefit they provide to the farm through farmyard manure. This is an important source of soil fertility in Khunda where the use of chemical fertilizer is quite low.

We argued in Section 5.1.2 that a particularly appropriate test for differences between the value of total output per acre of owner-cultivators and share-croppers may be the test of differences for the two categories of land for owner-cum-share-croppers. We present the result for such a test for Khunda and Jatli in Table 5.10. In both villages we find no significant differences in the mean values of total output.

In Khunda the Cheungian result for owner-cum-share-croppers underlines the importance of landowners' strong bargaining power vis-a-vis the share-cropper. Those share-croppers who also own land have a higher opportunity cost of labour (and thus a higher wage rate) as compared to landless share-croppers, since they can always rely on their own piece of land if things get really bad. This improves their bargaining position so that, at best, landowners can expect to get as much output on the share-cropped land as on the self-cultivated land.

Theory predicts that we should expect to observe no differences on owner-cultivated land and fixed-rent farms. This conclusion is supported by the empirical evidence in Mehdiabad. The results are given in Table 5.11.

Table 5.10 T-tests for differences in the mean value of total output on owned and rented plots of owner-cum-share-croppers in Khunda and Jatli

	No. of Cases	Mean	Standard deviation	T-Value	2-tail probability
KHUNDA					
Own land		95.40	87.08		
	16			-0.21	0.84
Share-cropped land		101.69	67.32		
JATLI					
Own land		323.22	184.13		
	20			-48.18	0.40
Share-cropped land		371.40	236.22		

Table 5.11 T-test for differences in the mean value of total output on owner-cultivated and fixed-rent farms in Mehdiabad

	No. of Cases	Mean	Standard Deviation	F Value	T Value	2-tail probability
Owners	21	937.09	462.08			
				1.79	-0.65	0.52
Fixed-rent tenants	19	1020.00	345.26			

Section 5.2.0 The incidence of tenancy

In a world without uncertainty, where perfectly competitive markets exist for inputs and outputs (and all inputs are divisible), households have identical production functions and constant returns to scale operate, there is no need for tenancies. A landowner increases the area he would like to cultivate to any size he desires by purchasing the requisite complementary inputs. In such a world, returns to management equal profits from own-cultivation (Bliss and Stern (1980)). The existence of tenancies in this neo-classical world may be explained purely in terms of historical factors that determine institutional arrangements. Neither the Cheungian nor the Marshallian analysis of tenancy (discussed in Section 5.1 of this chapter) is really relevant.

In the real world, however, markets are imperfect, many inputs are characterised by indivisibilities, managerial skills vary across individuals and uncertainty prevails. All of these factors either separately or through their interaction may result in the existence of tenancies. In the present Section we shall discuss and then empirically test a model of tenancy that captures such departures from the ideal neo-classical world. The model was developed by Bliss and Stern (1980) and it is particularly suited to village economies.

Section 5.2.1 The Model

The Bliss and Stern model (henceforth B-S model) explains the functioning of the tenancy market in a village (Palanpur in India) in terms of short term adjustments. They observe that markets in the village are different from the neo-classical paradigm in a number of ways. The most important difference, as far as the creation of tenancies is concerned, is the degree of imperfection in the labour and bullock markets. Labour market imperfections arise both due to high costs associated with finding a job outside the family farm as well as due to the disutility associated with working for others. Further, family members working outside the family farm may not be available to meet the seasonal requirements of the family farm because of the high costs of mobility (e.g. difficulties of finding jobs that allow seasonal leave of absence from work).

Imperfections in the bullock market arise because of the absence of markets for the services of bullocks. Also, it is difficult to arrange exchanges of bullocks of varying strength to suit the seasonal demand for draught power on the farm.

In the village economy, draught power and family labour are the two most important inputs used in the production process. Due to imperfections in their markets, size of the economically-efficient farms may be restricted. Farm size may be defined in terms of desired cultivated area (DCA) i.e.

$$DCA = q \; (WAMALVAL, ADMCULT) \qquad (1)$$

where WAMALVAL is the value of draught power owned by the household, ADMCULT is the number of adult males working on the family farm and q is a non-decreasing function.

The lack of markets for the two inputs implies that DCA is more or less predetermined for the household at the beginning of the crop season. If the household's DCA is less than the total land it owns then it leases land out otherwise it leases land in, i.e.

$$NLI = DCA - LANDOWN \qquad (2)$$

where NLI is Net Land Leased in. LANDOWN is the total land owned by the household.

The model, therefore, postulates that given imperfections in bullock and labour markets, adjustments in land-labour factor ratios on the farm are made through the market for tenancies. An adjustment mechanism is then outlined so that (2) may be rewritten as :

$$\text{NLI} = h\,(\text{DCA} - \text{LANDOWN}) \qquad (3)$$

The adjustment mechanism h is governed by the following rules :

(i) $h(0) = 0$ i.e. the farmer cultivates his desired cultivated area when it equals his LANDOWN.

(ii) $0 < h' < 1$ i.e. an excess of DCA over LANDOWN results in land being leased in but there are costs of operating in the tenancy markets so that full adjustment is not achieved.

(iii) There is no interaction between LANDOWN and DCA. The possibility of LANDOWN determining DCA due to greater access to credit is not allowed.

The adjustment mechanism incorporated in the function h captures the difficulties associated with obtaining land on lease. These will vary across both potential tenants as well as potential landowners. Tenants who are well-known in the village for their hard work find it easier to get land on lease. In our villages, for instance, landowners ranked tenant households by their ability to work hard and generally preferred to rent out land to tenants belonging to 'biratheries' 1/ that are well-known for their sound cultivation practices. Similarly landowners owning land with rich soil and less fragmentation find it easier to get tenants. Generally speaking, however, it appears that leasing out is easier than leasing in. The adjustment mechanism discussed here has a parallel in the capital stock adjustment models of investment theory. In these models,

---

1/. These have been discussed in Section 3.3, Chapter 3.

however, there is a logical inconsistency. Difficulties of adjustment to the desired capital stock are grounded in uncertainty. But these uncertainties are also likely to influence the 'desired' capital stock. In the B-S model these logical inconsistencies are avoided by separating the contractual uncertainties of adjustment from the determination of the desired cultivated area.

Substituting from (1), (3) may be rewritten as :

$$NLI = h\ (\ q\ (WAMALVAL,\ ADMCULT) - LANDOWN\ ) \qquad (4)$$

Taking a local approximation (4) becomes :

$$NLI = constant + r\ q_w\ WAMALVAL + r\ q_a\ ADMCULT - r\ LANDOWN \qquad (5)$$

where q_w is the partial derivative of q with respect to WAMALVAL,
q_a is the partial derivative of q with respect to ADMCULT

and $r = \dfrac{dh}{d(DCA - LANDOWN)}$

The equation to be estimated is :

$$NLI = a_1 + a_2\ WAMALVAL + a_3\ ADMCULT - a_4\ LANDOWN + U \qquad (6)$$

where a_1 is the constant term $a_2 = r\ q_w$; $a_3 = r\ q_a$; $a_4 = r$

and U is the error term with mean 0 and constant variance.

The model suggests another equation for estimation. Total area cultivated (TCULT) by a household is defined to be :

$$TCULT = LANDOWN + NLI \qquad (7)$$

Considering (1) and (2) this implies that

$$TCULT = DCA = q\ (WAMALVAL,\ ADMCULT) \tag{8}$$

A linear approximation to (7) gives :

$$TCULT = constant + q_w\ WAMALVAL + q_a\ ADMCULT \tag{9}$$

The adjustment process in (9), of course, is very strong. It implies a complete adjustment of total cultivated area to the desired cultivated area, i.e. $h = 1$. We shall test this empirically.

Section 5.2.2

Labour markets in our four villages are characterised by considerable imperfections. Of the two 'barani' villages, employment opportunities in Khunda are few even during the harvest season. Farm employment outside the family farm is restricted because of the general agricultural conditions of the 'barani' regions (see Chapter 3). The traditional pattern in the village is to seek non-farm employment in services such as the police and the military. The other alternative is to migrate to Rawalpindi, at a distance of 25 miles from the village. This non-farm employment pattern suggests that seasonal adjustment in ADMCULT in Khunda is quite difficult so that the assumption of a given ADMCULT at the start of the season is realistic. Long run adjustments do take place so that as employment opportunities increase outside the farm ADMCULT is reduced with the consequent reduction in DCA and NLI. The other 'barani' village, Jatli, is somewhat different. It is situated very close to the national highway. Consequently, labour mobility is high. Being a centre of the Integrated Rural Development Programme (see Chapter 3), there is a high proportion of households using tractors which relaxes the constraints imposed due to the lack of markets for services of bullocks. These are important factors in influencing agricultural activity in the village. This sets Jatli apart from the other three villages so that we do not expect the B-S model to be a good description of the tenancy market in this village.

Although non-farm employment opportunities in the irrigated villages are considerably greater than in the 'barani' villages, the incidence of non-farm employment is not very widespread in Mehdiabad and Chak. This may be due to the disutility of working for others by the traditional cultivating 'biratheries', particularly in the same village. Some family members move to another village or to the nearest rural town in search of employment. Such moves imply that costs of seasonal adjustment of ADMCULT back on the farm are high.

We have already seen in Chapter 4 that markets for the services of bullocks are virtually absent in all four villages. There is some exchange of bullock services but it is quite informal and hard to measure because money is not used in the transaction.

It is reasonable to assume, therefore, that DCA is predetermined at the start of the season by the availability of WAMALVAL and ADMCULT to a cultivating household. Given this DCA, a cultivator adjusts his total cultivated area by participating in the market for tenancies and thus adding to or subtracting from the total land that he owns. Equations (9) and (6) of the basic B-S model, therefore, are a reasonable representation of the tenancy markets in three of our villages. However, within the villages there are likely to be important structural differences affecting the adjustment mechanism postulated in the model. We shall test these differences empircally and comment on them.

Section 5.2.3

The two versions of the basic B-S model of tenancy include the following variables :

Dependent variables : NLI ; TCULT.

Independent variables : WAMALVAL ; ADMCULT ; LANDOWN.

We have already defined all the variables listed above except TCULT. This variable measures area cultivated with important crops [1/] in the four villages. It takes into account different cropping patterns in the 'barani' villages and irrigated villages. In the two 'barani' villages TCULT is defined as :

$$TCULT = CULTW + CULTG + CULTM + CULTB + CULTP$$

In the two irrigated villages :

$$TCULT = CULTW + CULTC + CULTM + CULTS + CULTF$$

where CULT refers to area cultivated under a crop and the suffix are :

W : Wheat ; G : Groundnut ; M : Maize ; B : Bajra

P : Pulses ; C : Cotton ; S : Sugarcane ; F : Fodder

We shall estimate equations (6) and (9) in our four villages for all cultivating households. Full time landless labourers and landowners who do not cultivate at all will be excluded, since a number of other factors not used in the construction of DCA are important in their decision not to cultivate. Both these categories of household have livestock (and therefore possible WAMALVAL) as well as family members

---

1/. In our discussion of Section 4.3, Chapter 4, we have given reasons indicating that the area under the important crops is a good approximation of the total cropped area.

(and therefore potential ADMCULT) yet their DCA is 0. In this case it is difficult to interpret the meaning of DCA. Clearly factors other than the availability of WAMALVAL and ADMCULT are respons ible for DCA being 0. A possible explanation may be traditional attitudes toward the'Kammi'castes that supply both full time as well as part time labour on the farm. These are traditionally landless castes. In other studies of Pakistani villages it has been reported that the pattern appears to be that nearly 20-22% of village labour force belongs to these castes (Gough and Sharma (1973), Barth (1965), Ahmed (1977)). These are descendants of traditional non-cultivating village castes whose numbers have increased due to high unemployment amongst the traditional village craftsmen (Ahmed (1977)). Landowners rank them lowest as potential tenants so that even if they do have access to WAMALVAL and ADMCULT their DCA may be 0. Landowners may, on the other hand, choose not to cultivate at all themselves because the highest ranking religious, foreign or local castes have traditionally considered it demeaning to cultivate land themselves (Ahmed (1977), Barth (1965)). (This attitude may change as profitability of agricultural cultivation increases and the labour effort required becomes less harsh with increased mechanisation.) Another reason for landowners' DCA being 0 may be due to employment in the non-farm sector in a nearby rural town or, as in the case of some small landowners, because of commercial interests as shopkeepers within the village. Since none of these factors are accounted for in the formulation of the DCA and non-cultivating households in the three equations to be estimated, their inclusion in the regression analysis is likely to result in specification errors. We shall therefore exclude these households while estimating equations (6) and (9).

Section 5.2.4 Regression results

In Table 5.12 we present the means and standard deviations of the variables used in our regression analysis.

The B-S model suggests that on average NLI in the villages should be zero. In our villages NLI has positive values because of transactions with other villages. In Jatli a surprising feature is the low man-land ratio. This may be explained by the existence of better employment opportunities for Jatli households because of the ease of access to the urban employment centres - the village being situtated near the main national highway linking Lahore and Rawelpindi. This low man-land ratio appears to affect the value of WAMALVAL for households in the village, which is very low compared to households in the other villages. This suggests a complementarity between human, bullock and, perhaps, tractors.

In Table 5.13 we report the estimated results of the basic B-S model. This corresponds to our equation (6). The estimated coefficients of equation (9) are reported in Table 5.15.

The estimated $\bar{R}^2$ values in Table 5.13 indicate that the basic B-S model is a good description of the tenancy market in Khunda but is less appropriate in Mehdiabad and Chak and quite inappropriate in Jatli. The R^2 values are 0.77, 0.35, 0.28 and 0.008 in the four villages respectively. The F-statistics indicate that the values are significant at 1% level of significance in Khunda, Mehdiabad and Chak, and insignificant in Jatli.

In Khunda the estimated values of coefficients on WAMALVAL and LANDOWN are significant at 5% level of significance. However, the coefficient on ADMCULT is significant at 10% level. In Mehdiabad all three coefficients are significant at 5% level. In Chak the coefficient on LANDOWN alone is significant at 5% level. The coefficient on ADMCULT

Table 5.12 Means and standard deviations (in brackets) of variables used in the regression analysis

	Khunda	Jatli	Mehdiabad	Chak
NLI 1/	9.63 (27.17)	1.25 (6.84)	8.16 (17.30)	1.75 (5.36)
WAMALVAL	3217.61 (3647.92)	849.16 (1487.65)	5669.22 (7541.14)	3281.64 (3734.71)
ADMCULT	1.62 (1.15)	0.98 (1.45)	2.53 (1.86)	1.61 (1.18)
LANDOWN	9.56 (33.95)	5.78 (5.30)	10.78 (27.97)	7.20 (8.16)
TCULT	20.92 (32.93)	7.55 (6.05)	18.82 (27.55)	5.79 (5.09)
N	194	179	73	114

1/. For definition of variables, see p. 226.

is significant at 10% level. The coefficient on WAMALVAL is not significant in this village. In Jatli none of the coefficients on the three independent variables are significant. The signs of all the statistically significant coefficients in the three villages are in accordance with the theoretical predictions of Section 5.2.1.

We argued in Section 5.2.1 that the value of the coefficient on LANDOWN will indicate whether or not full adjustment takes place to the Desired Cultivated Area. The value of 1 implies that the model as presented in equation (9), is the true description while a value of less than 1 would imply that there are difficulties in complete adjustment. Our estimated coefficients on LANDOWN in Khunda, Mehdiabad and Chak are respectively -0.76, -0.29 and -0.35, which are all significantly different from 1 (alternatively, 1 lies outside the confidence interval constructed allowing 5% chance of committing type 1 error). Thus the adjustment mechanism is important in our villages and the relevant model is that of equation (6).

An interesting feature of the values of the coefficient on HOLDCULT is that they allow the ranking of the villages according to the difficulty of adjustment (the difficulty increases as we move away from 1). Thus, adjustment is least difficult in Khunda, followed by Chak and Mehdiabad.

We have observed that our model of equation (6) is inappropriate for Jatli. This is not very surprising when we consider that of the four villages, Jatli conforms least to the traditional rural setting of the Punjabi villages. Being close to the national highway, households in Jatli have easy access to urban labour markets. This affects the cultivation practices in the village. We have already noted the high use of inputs such as fertilizer and the high incidence of tractor use in this village. As we shall see in Chapter 7, the incidence of non-farm incomes is also high in this village. Clearly there are non-traditional factors

Table 5.13 Estimation of B-S Model-Equation (6)

Dependent variable : NLI 1/

Villages / Indep.Variables	Khunda	Jatli	Mehdiabad	Chak
ADMCULT	1.48 (3.10) 2/	-0.44 (1.46)	2.53 (5.11)	-0.58 (2.23)
WAMALVAL	0.00218 (56.77)	0.00016 (0.204)	0.00099 (11.50)	0.00016 (1.82)
LANDOWN	-0.76 (632.57)	0.00013 (0.0001)	-0.29 (11.50)	-0.35 (40.59)
CONSTANT	7.49	1.55	-0.70	2.85
R^2	0.77	0.008	0.35	0.28
F	214.46	0.50	12.14	14.07
S.E. of regression	13.07	6.87	14.30	4.61

1/. For definition of variables, see p. 226.

2/. Figures in brackets are F-values.

determining behaviour in this village. These factors are also likely to affect the decision to rent land. The excellent connection with the urban labour markets has the consequence of removing some of the constraints on the working of the village labour market. Further, a highly developed market for tractor services removes the rigidities in the market for bullock draught power. Since our model stresses the importance of these two variables in determining tenancy, we shall conclude that it is not appropriate for villages where non-traditional factors operate to remove the traditional constraints on markets for factor services.

The reported estimates of coefficients on ADMCULT and WAMALVAL in Table 5.13 are actually multiples of two factors as suggested in the theory underlying the three equations as discussed in Section 5.2.6. The coefficients on WAMALVAL and ADMCULT, therefore, are composites of the influence of the relevant independent variables as well as the influence of LANDOWN. In Table 5.14 below, we present the coefficient values capturing the influence of the relevant independent variables alone. (We do not report the results for village Jatli here because we have seen that our model for tenancy is inappropriate for this village.)

Table 5.14 Influence of factors 1/ on the net land rented in

Villages / Inputs	Khunda	Mehdiabad	Chak
ADMCULT	1.95	7.23	2.07
WAMALVAL (x 1000)	2.87	3.41	0.57
LANDOWN	-0.76	-0.29	-0.35

1/. For definition of variables, see p. 226.

The values of the coefficients for each village indicate, respectively, the increment in the Net Area Leased In, at the margin, due to an increment of one adult male cultivating the family farm, a one thousand Rs worth of increment in the value of draught power and an increment of an acre of land owned.

Our estimated values may be compared with those estimated by Bliss and Stern in Palanpur. These are approximately 1, 3 and 0.78 respectively for their measure of the three variables (after converting their measure of the dependent variable (bighas) into acres). The difference between these values and those of our villages suggests the village-specificity of the model. Two points need explanation. One is the relative importance of factors explaining the difference between the estimates in Palanpur and our villages and the other is the across village variation for our three villages.

Our estimates suggest that in Khunda and Chak an additional cultivator per household results in an addition of nearly two acres of land leased in, while in Mehdiabad the addition is of 7 acres. The exceptionally high value in Mehdiabad is difficult to explain. There is nothing obviously superior regarding the ability of cultivators in this village compared to Chak. The high value may reflect landowner preferences, or the greater ability to rent land in a village where canal irrigation is regular and tenants have easy access to tube-well water. The generally higher values of this coefficient in the Punjabi villages compared to Palanpur may be due to differences in the population pressure on land in the two regions.

Table 5.14 indicates that a thousand Rs worth of draught power in Khunda and Mehdiabad results in an increment of approximately three acres of land. This compares quite well with the results in Palanpur. The value in Chak is exceptionally low (nearly a sixth of the other villages).

This may be explained by the high percentage of land cultivated with tractors in the village.

The estimated results of equation (9) are presented in Table 5.15. The value of R^2 falls in Khunda and in Chak. The coefficient on WAMALVAL is significant in all four villages, indicating the importance of draught power in determining total area cultivated. Some of the other results of this equation have already been discussed in relation to the results of the basic model of equation (6). Our conclusion is that the complete adjustment of total cultivated area to the desired cultivated area, suggested by the model of equation (9), is not supported by empirical evidence.

Table 5.15 Estimation of B-S Model-Equation (9)

Dependent variable : TCULT 1/

Villages / Independent Variables	Khunda	Jatli	Mehdiabad	Chak
ADMCULT	-2.36 (2.09) 2/	0.06 (0.04)	-0.75 (0.30)	1.03 (7.01)
WAMALVAL	0.0059 (131.76)	0.00086 (7.77)	0.0027 (64.23)	0.0003 (5.19)
CONSTANT	5.70	6.75	5.44	3.21
R^2	0.41	0.05	0.32	0.11
F	66.76	4.31	37.13	6.86
S.E.	25.39	5.94	19.46	4.85

1/. For definition of variables, see p.226.

2/. Figures in brackets are F-values.

Section 5.3 Conclusions

In Section 5.1 we have argued that the relative efficiency between share-cropped and owner-cultivated farms is determined by the landowners' bargaining power. The Cheungian result that suggests that there is no difference on the two types of farms, holds true when labour markets are such that share-croppers' alternative employment opportunities are high. In areas with high uncertainty of getting employment in labour markets (such as our village Khunda), landowners have superior bargaining power which they may exercise by demanding greater labour effort on the share-cropped farm as compared to owner-cultivators.

There is likely to be some conflict between landowner and tenant regarding acreage under fodder cultivation. To the extent that fodder is not shared equally between landowner and tenant the latter is likely to grow more fodder crops in order to raise the value of his livestock. In regions with low use of chemical fertilizers, landowners may actually encourage share-croppers to have larger values of livestock for their farmyard manure.

Owner-cum-tenant farms are Cheungian regarding relative efficiency of their owned and rented plots, since landowners' bargaining power <u>vis-à-vis</u> this category of farmers is constrained by the latter's ability to sustain themselves, even if they are unable to rent land. Because of the general land scarcity, low employment opportunities in the non-farm sector and active landowner supervision, the Marshallian disincentive effect does not hold in our villages.

Our results further suggest that the seasonal variations in employment opportunities are likely to affect landowners' bargaining power <u>vis-à-vis</u> the share-croppers.

Finally, our results suggest that other forms of tenurial contracts, such as fixed-rent tenancies are as efficient as farming by owner-cultivators.

In this chapter we have not presented a detailed discussion regarding the impact of tenurial arrangements on the use of modern inputs such as tube-well irrigation and cultivation with tractors. We did, however, discuss fertilizer use, but with respect only to Mehdiabad. In Chapter 6 we shall take up these issues again and attempt to analyse the impact of tenurial arrangements on the adoption of the 'green revolution' technology in the four villages and in Khanewal.

In determining the incidence of tenancy in Section 5.2, we argued that factor market imperfections regarding services of labour and bullocks are quite important. Participation in the tenancy market increases when bullock services cannot be easily hired and when non-farm employment opportunities are low. The model that we have estimated assumes that such rigidities exist in the short run and describes the adjustments taking place through the markets for tenancies.

An important way in which rigidities in the markets for labour and bullock services may be affected is due to the introduction of tractor cultivation. Tractors may not necessarily increase productivity but they do substitute human and bullock labour on the farm (Binswanger (1977)). This is likely to influence the markets for tenancies given our description of the workings of the market. It is important, however, to distinguish between tractor ownership and tractor use, since the impact of the two on the tenancy market is likely to be different. The distinction may be made on the basis of whether or not markets for tractor services exist.

Official policy has encouraged the use of tractors by incorporating a clause in land reform regulations that allows the retention of additional acreage (up to 30 acres) by landowners above the land ceiling, if a tractor is purchased for cultivation (Chaudry and Herring (1975)). The import of tractors has been encouraged through fiscal measures such as low import duties and low taxes on diesel fuel.

The overall evidence on the impact of mechanization from Punjab and the four districts to which our villages and Khanewal belong is given in Table 5.16. It appears that owners of tractors increase the area they cultivate after the purchase of tractors. In Punjab, on average, those cultivators who increase their acreage , increase it by 49.24 acres per farm. Some of this acreage may represent purchase of additional land but it is more likely that the bulk of it represents land resumed for self-cultivation that was previously rented out. (It is interesting that this increase in acreage is quite close to the recommended acreage, 50 acres, for the most popular make and horsepower of tractor, the Massey-Ferguson 35.)

This evidence suggests that the rigidities of bullock and labour markets may no longer be important. Clearly, if perfect markets for tractor services existed there would be no need for tenancies at all, as the B-S model describes. Landowners could easily adjust tractor services given endowments of land. However, markets for tractor services (although they exist widely as we shall discuss in Chapter 6) are imperfect, so that adjustments by small landowners who cannot purchase or have easy access to tractors may still be described by the B-S model.

Despite the availability of tractors, tenancies may continue to play an important role due to rigidities in managerial skills. Tractors may easily displace a tenant's human and bullock labour, but it is a poor substitute for his skills of husbandry. With the development of markets for tractor services, landowners may rent out both tractors as well as land. In Khanewal we were informed of a tenancy contract that is gaining

Table 5.16 Area added to farming by private tractor owners after the purchase of tractors

	Total Owners (No.) 1.	Owners reporting no addition (No.) 2.	Owners reporting addition (No.) 3.	3 as % of 1 (percentage) 4.	Area added (acres) 5.	Mean area added (acres) 6.
Punjab	26230	18185	8045	31	396140	49.24
Rawalpindi	162	75	87	54	1290	14.83
Campbelpur	342	221	121	35	22414	185.24
Lyallpur	2406	1809	597	25	18473	30.94
Multan	3110	2285	825	27	36994	44.81

Source : Pakistan census of Agricultural Machinery 1975.

considerable popularity. In this contract, landowners rent out land as well as tractors to share-croppers and lower tenants' share of output from ½ to anywhere between 1/5th and 1/8th. Other cases were pointed out where small landowners reduced their area cultivated (by renting out land) in order to sell tractor services (since household members are needed as tractor drivers).

Evidence from two of our irrigated villages on tractor use (to be discussed in Chapter 6), indicates that tractor cultivation is quite widespread. This suggests a need for caution when interpreting our results on the incidence of tenancy, in Section 5.2.

CHAPTER 6

Technological innovation

Section 6.0 Introduction

In this chapter we shall discuss the evidence on the use of 'green revolution' technology inputs by farmers differentiated by size and tenurial arrangements. We shall also comment on the impact of technological change on the relationship between size and productivity, and on rental contracts, and point out the adjustments made in rural markets to accomodate the new technology.

In Chapters 4 and 5 we presented an empirical investigation of the issue of efficiency in agricultural production. In Chapter 4 we discussed the relationship between size and productivity. We observed that the evidence in all four villages indicates that output per acre is a declining function of the size of holding. We offered a number of explanations for the existence of the inverse relationship in terms of the working of rural factor markets. We argued that rural land and labour markets are such that small farmers cultivate more intensively by applying more family labour on better quality soils as compared to large farmers. Attitudes towards risk may also be important in explaining the inverse relationship. In Chapter 5 we presented a discussion of the relationship between tenancy and productivity. We argued that share-cropping tenants may be as efficient in production as owner-cultivators and fixed rent tenants provided cost-sharing and supervision arrangements are built into rental contracts.

In Chapter 2 Section 2.3 we discussed the nature of technological change in Pakistani agriculture and examined its likely impact on the traditional size-productivity relationship. We reviewed, critically, arguments which suggest that the adoption pattern of the new technology is such that it may bring about a reversal of the traditional inverse relationship between size and productivity. If this argument holds, our observation in Chapter 4 that the inverse relationship exists in all four villages implies that very little technological change has occurred in the four villages. If, on the other hand, the direct evidence on adoption suggests that technological change has occurred, we need to examine the adjustments that are made in rural factor markets to accommodate technological change so that the traditional inverse relationship between size and productivity is maintained. In the present chapter we shall examine the direct evidence on technological change taking place in our four villages (and the sample of farmers in Khanewal) and discuss the nature of adjustments taking place in rural factor markets.

Let us examine the main argument more carefully. The existence of inverse relationship between size and productivity is explained in terms of functioning of rural factor markets. 'Green revolution' technology requires cash outlays on expensive inputs such as fertilizers, H.Y.V. seeds and tube-wells. Thus, rural capital markets are very important in determining the adoption pattern of the new technology. Given this importance of rural factor markets and given also that typically large farmers have better access to these markets compared to small farmers it may be argued that large farmers use the new inputs more intensively compared to small farmers so that the traditionally observed relationship between size and productivity may be reversed.

The above argument holds if it can be shown that small farmers use less of the inputs associated with 'Green revolution' technology as compared to large farmers. This requires a careful examination of the direct evidence on input use. If we observe that small farmers use new inputs no less intensively than large farmers, we need to discuss the nature of adjustments that take place in the factor markets that facilitate small farmers' access to new inputs. For example, markets may develop for services of new inputs like tube-wells so that small farmers can use tube-well irrigation even if they do not own tube-wells. Similarly, for fertilizer, local privately owned distribution points (such as the village shopkeeper or 'arhtia') may emerge to compensate for the inefficiencies of the government supply depots. In this Chapter we shall present a discussion of some of these issues.

It may be argued that not all tenural contracts facilitate technological innovation. For example, we have seen in Chapter 5 that one way of achieving efficiency of resource allocation in share-cropping tenancies is to allow for cost-sharing arrangements in the contract. These arrangements may be difficult to achieve in an environment of changing technology because of disagreements between landowners and tenants regarding expected returns to investment in new inputs. This may result in lowering the incidence of share-cropping tenancies compared with owner cultivation and fixed-rent tenancies. (C.H.H.Rao (1971)). In the present Chapter we shall comment on the likely influence of technological change on the choice of rental contract by examining the direct evidence on use of new inputs by different tenural cateogires in the four villages. Using evidence from Khanewal we shall also comment on adjustments made in tenural contracts that facilitate adoption of technology.

A hypothesis that we shall test in our analysis in this Chapter concerns the impact of migration on adoption of new technology. It has been argued that rural-urban migration of household members from small farms results in remittances back to the farm. This enables the farmers to use new inputs and thus to relax the constraints imposed by imperfections in rural capital markets (O.Stark (1975)). In the present Chapter we shall briefly examine the evidence concerning this hypothesis. A more detailed discussion of migration will be presented in Chapter 7.

In Section 6.1 we shall identifythe inputs that we shall examine to discuss the pattern of technological change. An aggregate overview of the pattern and the distinction between purchase and use of the new inputs will be discussed. Our hypotheses regarding the impact of size and tenancy on use of the new inputs will be discussed in Section 6.2. Evidence from the four villages and from Khanewal will be presented in Section 6.3. Finally, conclusions will be given in Section 6.4.

Section 6.1 The relevant variables

It is difficult to determine the precise vector of activities and/or inputs that distinguish new technology from the old. Conceptually a distinction may be achieved by considering two farms that are similar in terms of factor endowments and produce equal output using identical technologies. We may now distinguish between old and new technology by changing the inputs used by one of the farms. For example, canal irrigation may be supplemented by tube-well irrigation and bullock cultivation may be substituted for cultivation with tractors. The new technology will be adopted on the farm if, as a result, farm output, net of costs, increases (here we have in mind all costs including the opportunity cost of leisure).

The four inputs that we shall be concerned with in our discussion are fertilizer, tube-well irrigation, tractor cultivation, and high yield variety seeds. Except for tractor cultivation, the inputs are considered essential ingredients of the new "Green Revolution" technology introduced in Pakistan in the mid-sixties. Tractor cultivation appears to be more a consequence of the introduction of the new technology rather than an essential ingredient.

A variable that we have included in our discussion is a measure of canal irrigation. This has been done because canal irrigation is an essential pre-requisite to the introduction of the new technology, and unlike other inputs, it is provided by the public sector. By comparing the impact of farm size and tenancy on canal irrigation with their impact on other privately purchased inputs (the hypotheses will be spelt out shortly), we shall comment on a special aspect of the role of public policy in agricultural development.

We argued that our main concern will be with those new inputs that contribute unambiguously in increasing output on the farm. While this may be true of chemical fertilizers, high yield variety seeds, tube-wells and canal irrigation, the contribution of tractors to output is less obvious. A discussion of the way in which tractors may contribute was presented in Chapter 5. It may be recalled that two main attractions of tractor cultivation are savings in costs of supervising hired labour and increase in the cropping intensity. Thus the net contribution of tractors to farm output may be unambiguously positive.

Section 6.1.2 An aggregate overview and the distinction between purchase and use of the new inputs.

In Table 6.1 below we have compared the use of some of the new inputs at both Punjab and the all-Pakistan level over the twelve year period, 1960-72. This period allows a convenient comparison of the extent to which farmers have switched over to the new technology. The new technology was introduced in the mid-sixties and was adopted extensively in the irrigated regions of the Punjab over this period. The adoption in other regions was slower and is reflected in the figures given in the Table.

Table 6.1 Farms using fertilizer, tube-wells and canal irrigation as a percentage of all farms in Pakistan and in Punjab (1960-1972)

Inputs	Area	1960 (1)	1972 (2)
Fertilizer	Pakistan	6	52
	Punjab	7	55
Tube-wells	Pakistan	0.3	28
	Punjab	0.4	42
Canal irrigation	Pakistan	53(68).[1]	37(74)
	Punjab	54(70)	26(75)

Source: Pakistan Census of Agriculture, 1960, Pakistan Census of Agriculture, 1972.

1. Figures in brackets are percentage of acreage under all types of irrigation

The comparison of figures in columns (1) and (2) clearly indicates sharp discontinuities which may be explained mainly by the introduction of the 'Green Revolution' technology. The figures in the last two rows show acreage cultivated with canal irrigation. The decline in the proportion of total irrigated acreage in the twelve year period is mainly due to the greater use of tube-wells. Figures in brackets in the last two rows show that total irrigation also registered an increase in this period. For all three inputs, the change in Punjab is greater than the change in Pakistan as a whole.

The importance of the distinction between ownership and use of both tractors and tube-wells becomes apparent in Tables 6.2 and 6.3 that show that in Punjab, at least, inability of the small farmers to purchase these inputs does not hinder their use. This can be seen by comparing Columns (2) and (3) in the two tables. A feature to note is that the facility to use inputs is not sharply affected across tenure. Further, while both small and large farmers use these inputs even when they do not own them, the ratio of farmers owning the inputs to those using them increases as the size of holding increases.

Table 6.2 Farms reporting ownership and use of tractors as a a percentage of all farms differentiated by size and tenure in Punjab

Tenure size-categories	All farms		Owner farms		owner-cum-ten farms		Tenant farms	
	owned	used	owned	used	owned	used	owned	used
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
under 1 acre	0.02	20	0.03	20	-	17	-	22
1.0-5.0	0.10	25	0.11	23	-	28	0.10	29
2.5-5.0	0.07	20	0.12	21	-	19	-	22
5.0-7.5	2	40	0.12	20	0.05	17	0.06	19
7.5-12.5	3	43	0.45	20	0.20	18	0.10	15
12.5-25.0	6	46	1	25	0.60	23	0.20	18
25-50	12	55	5	32	3	33	0.80	26
50-150	10	99	18	48	14	52	6	55
150 & above	39	67	35	58	47	82	40	95
Total	1	22	1	23	1	23	0.3	20

Source: Pakistan Census of Agriculture, 1972.

Table 6.3 Farms reporting ownership and use of tube-wells as a percentage of all farms differentiated by size and tenure in Punjab

Tenure size-categories (1)	All farms owned (2)	All farms used (3)	Owner farms owned (4)	Owner farms used (5)	owner-cum-ten farms owned (6)	owner-cum-ten farms used (7)	Tenant farms owned (8)	Tenant farms used (9)
under 1 acre	0.40	27	0.50	25	-	29	-	32
1.0-5.0	0.80	32	1	29	1	37	0.20	41
2.5-5.0	2	37	2	29	2	39	0.40	42
5.0-7.5	2	40	2	34	2	41	0.60	44
7.5-12.5	3	43	3	30	3	43	0.80	44
12.5-25.0	6	46	9	42	7	49	1.20	48
25-50	12	55	18	47	13	55	3	64
50-150	26	65	30	55	25	61	13	-
150 & above	43	70	38	57	55	83	43	-
Total	5	42	37	37	6	46	-	47

Source: Pakistan Census of Agriculture, 1972.

The widespread use of tractor services by farmers as seen in Table 6.2 has interesting implications for the development of rural factor markets. In Chapters 4 and 5 we presented, at some length, the reasons for the non-existence of markets for bullock services in Pakistani agriculture. The introduction of tractors appears to have removed some of the traditional constraints on the development of markets for ploughing. In turn, this removes the constraints on the amount of land that the landowners may cultivate. We briefly discussed the issues involved in Chapter 5.

The differences in tube-well ownership and use across farms differentiated by tenure are evident from Table 6.3. This is again explained by the existence of markets for tube-well irrigation. The provision of tube-well water removes some of the constraints of cultivation imposed by the limitations of the publicly provided canal irrigation which is dependent on the efficiency of the irrigation department and rainfall to a much greater degree than tube-wells. In Pakistan the development of markets for tube-well water rapidly followed the introduction of the 'Green Revolution' technology and was instrumental in removing the bottlenecks of publicly provided canal irrigation thus facilitating the use of the new inputs.

The development of markets for factor services may be explained as a response of agents, concerning resource allocation, in an uncertain environment. Costly inputs with excess capacity may be purchased by large landowners as well as middlemen in the rural areas to diversify their investment portfolios. Large owners may purchase tractors or tube-wells with the intention of selling the excess capacity to other farmers who would like to use the inputs but do not own them. This additional source of income may reduce the risk of the investment portfolio compared to one where the entire income is earned from cultivation alone. Similarly, middlemen trading in agricultural commodities (both inputs and outputs) and providing rural credit may also diversify their investment portfolios by purchasing tractors and tube-wells. On the demand side, small owners of land may attach high risk to the purchase of an expensive input (they may simply not have access to the loans to purchase the inputs). However, payment for input services may be considered less risky since the loss is relatively small. For tenants, an important explanation for not buying the inputs is insecurity of tenure. This is particularly important for investment in tube-wells because of their immobility. Both share-croppers as well as fixed rent tenants are vulnerable to such insecurity.

Introduction of new inputs may result in weakening traditional social relations that discourage development of markets for factor services. For example, renting out tractors may not involve the same social taboos as renting out bullocks for ploughing because of the emergence of specialized labour such as tractor drivers whose skill is divorced from ownership. In the case of the market for tube-well water an important explanation may be the increase in capacity for drawing water by electric/diesel motors, compared to persian wheels, which allow irrigation of plots other than those in the immediate vicinity.

Section 6.2 The Hypotheses

In the preceding discussion we noted the distinction between ownership and use. We argued that because of the development of markets for factor services small size farmers as well as tenants have access to inputs that they do not own. We shall now develop specific hypotheses concerning the relationship between the use of inputs and the factors that influence it. The factors that we shall emphasize in our discussion are size, nature of the tenurial contract and migration.

The Size of Farm

The relationship between size of holding and use of inputs associated with 'Green Revolution' technology may be explained in terms of differences across farms regarding access to new inputs as well as by differences in attitudes towards risk-bearing.

Clearly, if large farms have better access to the new inputs, they are at an advantage compared to small farmers and this may explain greater use of new inputs on such farms. (The distinction between 'access' and 'use' will be made clear in the discussion that follows). In input markets distribution is determined, in part, by the price of the input. If there is great demand and markets are competitive many small farmers will be priced out of input markets particularly if rural credit facilities are inadequate (Byers (1972)). Alternatively, the distribution of input may be influenced by Government through a policy of price controls. This is likely to result in a system of patronage which will again favour large farmers because of their greater mobility and political connections and hence access to the Government supply depots. However, not all inputs that constitute modern technology are affected in this manner. Two examples can be cited readily and have been discussed in detail earlier in Section 6.2. These are irrigation with tube-wells and ploughing with tractors. Both inputs require large investment which is likely to be beyond the means of small farmers. However, lively markets have developed for the services of such inputs. Water for irrigation is purchased by small farmers in fairly competitive markets in most regions where tube-wells exist. This is also true for tractor services.

Even if access to input markets does not favour large farmers and rural credit markets function quite well, there may be differences in the attitudes of small and large farmers towards new technology due to differences in risk aversion. (Our discussion here is concerned with input use alone — note the distinction between ownership and use pointed out earlier). In our discussion presented in Chapter 2, Section 2.1, we argued (using the arguments suggested by Srinivasan (1972) and Bliss and Stern (1980)) that risk is important in determining resource allocation on the farm. It was pointed out that the relationship between use of inputs and size of holding is determined by differences in relative and absolute risk aversion. Thus, if increase in the size of holding lowers absolute risk aversion size will be positively correlated with the intensity of input use. On the other hand, if relative risk aversion increases with an increase in the size of holding, intensity of input use declines. We shall extend this argument to the new inputs that define modern technology.

On the basis of the discussion presented above we shall argue that size of holding is an important determinant of use of new inputs.

Tenancy

It is argued by Bhaduri (1971) that share-cropping tenancy in India is an aspect of "semi-feudalism" in which landless peasants contract not only land but also credit for consumption from the landowner who has monopolistic powers in the two markets. Both rent from land and interest on capital are argued to be important sources of landowner's income. The model is developed in the framework of a single commodity (paddy) economy. It is shown that if the objective of the new technology is to raise output, debt owed by tenants to their landowner will be reduced. This will exhaust an important source of income for the landowner. At the same time it will loosen the landowner's hold over the tenant because one of the markets in which he acts as a monopolist is no longer tightly controlled by him. Thus it is in the interest of the landowner to discourage share-croppers from adopting the new technology. Bhaduri allows for the possibility where the introduction of new technology raises output sufficiently to compensate the landowner (through his share in the increased output) for the loss of income from usu ry. But, it is argued, that even this is not very attractive for the landowner since it reduces his ability to exploit the tenant which is greater when he controls both land and credit markets.

The argument presented above may be evaluated at two levels. The first requires us to verify, empirically, whether the assumptions of the model can be generalized. The second requires us to determine whether the logic of Bhaduri's argument is sound, and consistent with the conclusions. We have seen in Chapter 3, Section 3.2, that while some landowners in our villages do exercise control over markets other than land, this is not the general practice. Thus landowners rely mainly on their rented land as the major source of income. The second assumption implies that the introduction of modern technology lowers indebtedness. This may be true for consumption loans.

The demand for production loans, however, is likely to increase when new technology is introduced since larger cash outlays are required to purchase new inputs such as seeds, fertilizer and irrigation water. Thus tenants' overall indebtedness is likely to increase. To the extent, therefore, that the tenant is dependent on the landowner, the relationship of dependence is likely to be perpetuated as a result of the introduction of the new technology. Thus it is not necessarily in the landowner's interest to discourage adoption of new technology.

Even if we accept Bhaduri's assumptions, it is not clear that his conclusions necessarily follow. If a landowner has monopoly in more than one market, it is possible for him to exercise his monopoly power in one of the markets. Thus even if the landowner's income from the interest charged on loans given to the tenant is reduced, he can lower the tenant's rental share in the tenancy market and thus he may reap the rewards of introducing the new technology. Such control by the landowner in the tenancy market is allowed in the model suggested by Cheung (1969) where landowner's monopoly in the tenancy market implies that the rental share enters the landowner's maximand as a choice variable. Alternatively, it can be demonstrated that landowners reap the benefit of new technology by constructing models in which tenant's income enters the landowner's maximand as a constraint. (See the discussion in Chapter 2 Section 2.2.)

It is important in the discussion of the relationship between tenancy and technology to distinguish between different types of tenurial arrangements. Thus owner-cum-tenants may respond differently to the new technology as compared to tenants. Amongst the tenants, share-croppers may respond differently from fixed-rent tenants because of the differences in incentives or risk aversion. Owner-cum-tenants are typically large farmers and have access to own wealth. It is likely, therefore, that they may be less risk averse than pure tenants (we have already discussed the relationship between farm size and the adoption of new technology). Fixed-rent tenants bear all the risk of cultivation and therefore may be reluctant to adopt the new technology if it requires large investment. Share-croppers, on the other hand, share risk with their landowners. We have seen in our discussion in Chapter 2 that if the costs of inputs are shared between landowners and share-croppers in the same proportion as the share in output, share-croppers are as efficient in resource use as owner-cultivators.

The arguments presented above attempt to explain the relationship between different tenurial arrangements and the adoption of modern technology. Our discussion of the sample of farmers in Khanewal given in Chapter 3 indicates that it is possible for us to evaluate differences in adoption of the new technologies on share-cropper farms distinguished on the basis of supervision methods of landowners. We argued in Chapter 3 that landowner's regular supervision is likely to keep the share-cropper 'on his toes' so that the landowner will successfully coax the tenant into adopting the unambiguously profitable new technology.

A hypothesis that we shall test may be seen to be the reverse of the one suggested by Bhaduri. In this scenario it is the tenant who is reluctant to introduce the unambiguously profitable new technology due to poor access to new inputs and high risk aversion. The landowner, on the other hand, has good access to inputs, as well as credit facilities and Government extension services and also has a relatively lower risk aversion. This makes him keen to introduce the new technology. It may be argued that in such a situation the landowner will attempt to reclaim land from tenants for self-cultivation. (This trend has been observed in a number of areas where the new technology has been introduced.) An indirect test of this argument may be to determine whether the land-owners who have reclaimed land from their tenants use the new inputs more intensively compared to share-croppers. We shall attempt such a test for our sample of farmers in Khanewal.

Rural-Urban Migration

In Chapter 7 we shall analyse, in detail, rural-urban migration of labour using data from the four villages. In this Section, we shall test a hypothesis that postulates that farmers encourage household members to migrate not only because the farm cannot provide the consumption need of the members, but also because migrant members remit cash back to the farm which is used to purchase the new inputs. This hypothesis will be elaborated further in Chapter 7.

In summary, our discussion of the impact of size, tenancy and migration on the use of new inputs indicates the following. The relationship between size and input use may be proportional or inverse depending on the nature of risk aversion, and farmers' access to capital markets and distribution points. Onwer-cum-tenants, in general, may be expected to use the new inputs more intensively than share-croppers who, in turn, may use them more intensively compared to fixed-rent tenants.

Further, share-cropping tenants who are supervised regularly by landowners may use the new inputs more intensively than other share-croppers. Finally, farmers with migrant members are likely to use more of the new inputs compared to other farmers. In the remaining sections of this Chapter we shall attempt to verify these arguments using evidence from our four villages and from Khanewal.

Section 6.3.1. The evidence from the four villages and from Khanewal

In this section we shall present a brief description of the incidence of use of the new inputs by different categories of farmers in the four villages. For Khanewal we shall also present a time profile of adoption. Intensity of use of the new inputs will be discussed in Section 6.3.2.

In Jatli (Table 6.4a) there are no fixed-rent tenancies. This explains the absence of entries in Columns 2 and 4. Due to the high costs of reaching subsoil water, there are no tube-wells in the village. Fertilizer is used extensively. It can be seen that fewer share-croppers use fertilizer as compared to owners and owner-cum-tenants. However, more share-croppers use modern seeds and tractors compared to the other two tenurial categories.

In Khunda (Table 6.4 b) also there are no fixed rent tenancies. It can be seen that apart from tractors, the use of modern inputs is not very common.

In Chak (Table 6.4 c) all cultivators use fertilizers and modern seeds. However, because sub-soil water is saline, tube-well irrigation is not possible. There appears to be considerable variation across tenure regarding tractor use. All fixed-rent tenants use tractors while amongst the owner-cum-tenants the incidence of tractor use is quite low.

The use of fertilizers and high yield variety seeds is quite widespread in Mehdiabad (Table 6.4.d). Comparatively, the incidence of tube-well irrigation is low and shows variation across tenure. Fixed-rent tenants appear to use tractors more frequently than share-cropping tenants. In general, however, the variation of tractor use across tenure is rather low.

This informal presentation of the evidence suggests that the use of fertilizers and high yield variety seeds is quite widespread in the canal irrigated villages. This confirms the view that irrigation is an important ingredient in the new "Green Revolution" technology package. Further, where irrigation is available, most farmers use the new input regardless of size and tenure (as we shall see, size and tenure are important in determining the intensity of use).

The other result worth noting is that tractor cultivation is widespread in both 'barani' as well as canal irrigated villages. This is indicative of the success of Government subsidy schemes in the spreading of the use of tractors.

Khanewal

In Table 6.4.e we have presented the use of modern inputs by farmers in Khanewal. All three inputs are used by nearly all the farmers we interviewed in Khanewal, regardless of the difference in tenure. This evidence supports the view that Khanewal sub-division is technologically one of the most advanced agricultural regions of Pakistan.

We have presented a time profile of the use of three modern inputs (fertilizers, tube-wells and tractors) in Khanewal in Table 6.5. If we take a three year period for measuring changes in technology, it can be seen from Table 6.5 - but more clearly from Figure 6.1 - that the incidence of fertilizer use and tube-well irrigation peaked in late 1960's.

Some years later - in early 1970's - all frequency bars register a fall suggesting that by that date few stragglers were left to catch up with the new technology. It is interesting to note the lag of one period between the use of tube-wells/fertilizers and tractors. This supports the view that 'Green Revolution' technology preceded mechanization. An important point to note in the height of the frequency bars of the three inputs is the suggestion of initial variation in response followed by a smooth trend in the incidence of use. This may be explained by the initial high risk associated with the new inputs by farmers as well as the slow development of markets for factor services. Initially, fertilizer distribution may have been poor and markets for the services of tractors and tube-wells may not have existed. However, by late 1960's, 68% of the farmers in our sample were using fertilizers and 63% were using tube-wells for irrigation. By early 1970's 51% of the farmers in the sample had access to tractors for cultivation.

The frequency of use of modern seeds can be seen from Table 6.6. The two most popular varieties currently in use are Chenab 70 (C-70) and Yakora (58% and 60% of the sampled farmers, respectively, report the use of these varieties). Another popular seed variety is Noori (34% of the sampled farmers use it).

Table 6.6.b shows the time profile of the use of high yield variety seeds by the sample farmers in Khanewal. The table has been compiled on the basis of farmers' response concerning the H.Y.V. varieties currently in use. Farmers' response to questions concerning the varieties actually sown was quite good. However, the response to our questions regarding the date of the initial use of the seed varieties currently in use was rather poor. We got the impression that apart from a few farmers who keep

written farm accounts, the majority did not remember the varieties used before 1970's. While presenting the time profile of the use of seeds in Table 6.6.b, we include the responses of only those farmers who seemed reasonably clear about the dates. For example, although Maxi-Pak Seeds (Maxi in Tables 6.6.b.) were very important in bringing about the 'Green Revolution' very few farmers were clear about the year they first used the seeds. On the other hand, farmers were quite clear regarding the initial use of the two varieties currently popular, Yakora and Chenab 70.

Table 6.4.a. Farmers reporting any use of the new inputs as a percentage of all farms in Jatli

Tenurial Categories / Inputs	owners (0)	share-croppers (1)	fixed rent tenants (2)	owner-cum-share-croppers (3)	owner-cum-fixed rent tenants (4)
Fertilizer	75	50	-	70	-
Modern Seed	35	50	-	33	-
Tractors	47	100	-	45	-

Table 6.4.b. Farmers reporting any use of the new inputs as a percentage of all farms in Khunda

Tenurial Categories / Inputs	owners (0)	share-croppers (1)	fixed rent tenants (2)	owner-cum-share croppers (3)	owner-cum fixed rent tenants (4)
Fertilizer	4	-	-	6	-
Modern Seed	0	-	-	0	-
Tube-wells	2	-	-	0	-
Tractors	54	36	-	81	-

Table 6.4.c Farmers reporting any use of the new inputs as a percentage of all farms in Chak

Tenurial Categories / Inputs	owners (0)	share-croppers (1)	fixed rent tenants (2)	owner-cum-share-croppers (3)	owner-cum fixed rent tenants (4)
Fertilizer	99	100	100	100	100
Modern Seed	97	100	100	100	100
Tube-wells	-	-	-	-	-
Tractors	33	33	100	0	21

Table 6.4.d. Farmers reporting any use of the new inputs as a percentage of all farms in Mehdiabad

Tenurial Categories / Inputs	owners (0)	share-croppers (1)	fixed rent tenants (2)	owner-cum-share-croppers (3)	owner-cum fixed rent tenants (4)
Fertilizer	100	100	100	100	100
Modern Seed	100	100	100	100	75
Tube-wells	29	25	20	13	38
Tractors	58	19	50	25	75

Table 6.4.e. Farmers reporting any use of the new inputs as a percentage of all farms in Khanewal

Tenurial Categories / Inputs	Share-croppers with no change 1/ (0)	Share-croppers with change (1)	owners without change (2)	owners with change (3)
Fertilizer	27	26	17	16
Tube-well	27	26	18	17
Tractors	27	26	18	17
Total	27	27	18	18

1/ Change refers to change reported in farm area in the last five years. (see the discussion on data in Chapter 1).

Table 6.5 Farmers reporting the year of 1st use of the new inputs in Khanewal (square brackets indicate that farmers have been bunched into groups of three years)

Inputs / Year	Tractors		Tube-wells		Fertilizer	
1950	1				1	
1951		1		0		2
1952					1	
1953					1	
1954		0		0		3
1955					2	
1956			1			
1957		0		2		0
1958			1			
1959						
1960	2	3	5	6		0
1961	1		1			
1962			5			
1963		4	1	10		5
1964	1		4		5	
1965	3		7		9	
1966	3	8	4	16	5	19
1967	2		5		5	
1968	2		4		9	
1969	5	10	13	20	13	32
1970	3		3		10	
1971	3		3		2	
1972	6	20	5	11	4	13
1973	11		3		7	
1974	8		2		4	
1975	6	17	5	8	2	8
1976	3		1		2	
1977	1		1		1	
1978	6		1		2	

Figure 6.1 Frequency of the 1st use of inputs by farmers in Khanewal by three-year periods.

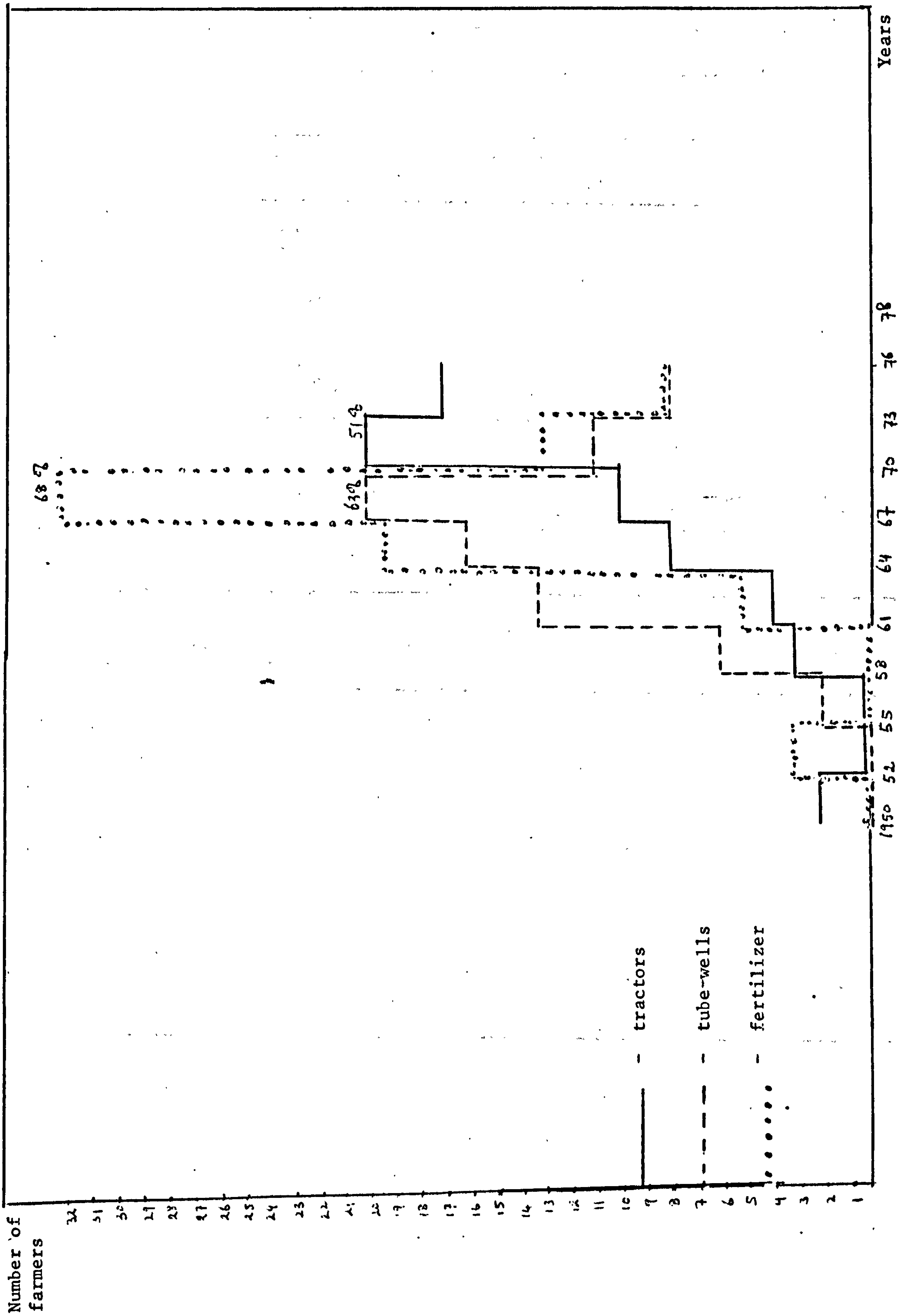


Table 6.6a Frequency of use of the eight high yield variety wheat seeds most frequently used by farmers in Khanewal (on part or all of the area under wheat crop

Seed Variety	Percentage of farms reporting use
Pawan	8
C70	58
Noori	34
S.A.42	13
MAXI	9
L.W.	2
SA75	6
YAKORA	60

Table 6.6.b Time profile of seed use. Number of farmers reporting the use of H.Y.V.Seeds by seed variety and year of use

Seed variety / Year	Pawan	C70	Noori	SA42	MAXI	LW	SA75	YAKORA
1965			1		1			
1966								
1967		1			1			
1968		1	1		1			
1969		2	1					1
1970		3						
1971		1			2			
1972					3			2
1973		4			2			2
1974		2	1		1			6
1975		4		2	1		1	18
1976		2		2				11
1977		4			1		1	4
1978	7	3		2	1		2	3

Section 6.3.2. The statistical model of input use

In the present section we shall discuss intensity of use of the new inputs in the four villages and in Khanewal in the framework of a simple linear model. We have already presented an informal discussion of the adoption pattern of the new technology. The model described here will be used mainly to test the hypotheses developed in section 6.2 regarding the intensity of use of new inputs. Our measure of the intensity of use of an input will become clear when we define the dependent variables in our discussion.

In its most general form the model suggests that intensity of use of the new inputs is a function of the size of holding and tenurial arrangements i.e.

$$Ni = f(H,T) \qquad (1)$$

where Ni is the proportion of total acreage under the i^{th} modern input
H is the size of holding
T is the tenurial arrangement

Throughout our discussion H will be measured as a continuous variable while we shall use dummies to distinguish between different tenurial arrangements. Taking into account the disturbance term the linear form of the model is

$$Ni = A + B_1H + \sum_j \beta_j T_j + u \qquad (2)$$

where j = 2...5 gives the dummies for the five broad categories of tenurial arrangements in our villages (discussed in Chapter 1).

According to (2) the differences in the intensity of use of the new inputs due to size are determined by the sign and significance of B_1 while the significance and sign of B_j will indicate the difference due to a tenurial category on the basis of comparisons with the intercept term.

In the estimations of our model in the four villages we shall introduce an additional dummy for migration so that in (2) $j = 2 \dots 6$ where the 6th term is the migration dummy. Keeping in view our discussion in Section 6.2 the dummy variable takes the value 1 if migrant members send back remittances and 0 otherwise. The addition of the migration dummy to our basic model will result in interaction terms. (See below.) We shall estimate the coefficients of each of these in order to determine the impact of migration.

Taking into account the five categories of tenurial arrangements in the four villages, the migration dummy and the interaction terms, the model may be written in full as :

$$N_i = A + B_1H + B_2T_2 + B_3T_3 + B_4T_4 + B_5T_5 + B_6T_6 + B_7T_{26} + B_8T_{36}$$

$$+ B_9T_{46} + B_{10}T_{56} + U \qquad (3)$$

where A is the constant term

H is the size of holding measured in acres

T_2 takes the value 1 for share-cropping tenant, 0 otherwise

T_3 " " " " " fixed-rent " , " "

T_4 " " " " " owner-cum-sharecropping tenant, 0 otherwise

T_5 " " " " " owner-cum-fixed-rent " " "

T_6 " " " " " households with migrant members " "

T_{26} is the interaction term for T_2 and T_6

T_{36} " " " " " T_3 and T_6

T_{46} " " " " " T_4 and T_6

T_{56} " " " " " T_5 and T_6

U is the error term

As we shall see some of the tenancy dummies and interaction terms will drop out in some villages given that not all five tenurial arrangements exist in all four villages.

The dependent variables used in the estimation of (3) are :

1. The value of fertilizer use per acre on the farm.
2. The proportion of total farm acreage cultivated with tractors.
3. The number of standard (see below) tube-well irrigations per farm.
4. The number of standard (see below) canal irrigations per farm.

Each of the dependent variables measures the aggregate use of inputs for all the crops taken together. The unit of observation in our model is the individual farm. A standard irrigation is called a 'Vaar'. It refers to the irrigation of all the acreage cropped in a season and is measured in terms of acre feet of water per cultivated field.

In Khanewal we shall estimate a different version of the model described above. Our data for the sample of farmers in Khanewal allow us to make subtle distinctions between tenurial arrangements. For example, we can distinguish between share-croppers whose total farm area (rented in or out) has remained unchanged in the five years before the survey with those whose landowners have reclaimed land. Also, we can make comparisons between owner-cultivators whose farm area has remained unchanged with those owner-cultivators who have reclaimed land from share-cropping tenants. These comparisons will enable us to comment on the ability of share-cropping contracts to accommodate technological change. Thus we shall test the hypothesis that share-croppers from whom landowners have reclaimed land are those who use the new inputs less intensively compared to other share-croppers. Another hypothesis we shall test is that owner-cultivators who have reclaimed land from share-croppers use the new inputs more intensively compared to other owner-cultivators.

We also test the hypothesis that share-croppers whose landlords exercise regular and close supervision use the inputs more intensively compared to others. Further, we shall examine whether cost-sharing arrangements affect the intensity of use of the new inputs.

In order to focus sharply on the tenurial distinctions discussed above we shall concentrate on the intensity of input use for the main 'rabi' crop, wheat.

In Khanewal the basic model (2) may be written as :

$$N_i = A + B_1H + B_2T_2 + B_3T_3 + B_4T_4 + B_5T_5 + B_6T_6 + U \qquad (4)$$

where A measures the intercept term for share-croppers whose farm area is unchanged.

- H is the size of holding in acres.
- T_2 takes the value of 1 for share-croppers whose landowners have reclaimed land, 0 otherwise.
- T_3 takes the value of 1 for owner-cultivators whose farm area is unchanged, 0 otherwise.
- T_4 takes the value of 1 for owner-cultivators who have reclaimed land for self-cultivation, 0 otherwise.
- T_5 takes the value of 1 for share-croppers whose landowners exercise regular supervision (i.e. visit the plot at least once a week, 0 otherwise.)
- T_6 takes the value of 1 for share-croppers whose landowners share the costs of modern inputs, 0 otherwise.

The dependent variables in Khanewal are:

1. The value of fertilizer used per acre on the farm for wheat crop
2. The number of standard tractor ploughings on the farm for wheat
3. The number of tube-well irrigations on the farm for wheat
4. The number of standard canal irrigation on the farm for wheat

'Standard' ploughings and irrigations are to be interpreted in the same way as in the discussion of the model of input use in the four villages.

Both equations (3) and (4) are estimated in their linear form. In Jatli we also tried the log-linear form but we did not find much improvement in the goodness of fit. Thus we shall present our results on the basis of the estimation of the linear form only.

Results

We have presented the results of the regressions that test our hypotheses concerning the use of modern inputs in the four villages (all crops) and in Khanewal (wheat only) in Tables 6.7-6.10. We have marked the values of the coefficients on independent variables with asterisks to indicate levels of statistical significance. (The actual regressions with the F-values of the coefficients on each independent variable and R^2 values of the regression equations along with the standard error, are given in Tables 6.11 to 6.15 in the Appendix.

Fertilizer

The results of tests of our hypotheses regarding per acre fertilizer use in the four villages are presented in Table 6.7. It may be seen that the size of holding is negatively correlated with the value of fertilizer used per acre in Jatli, while in Mehdiabad the correlation is positive. In Khunda and Chak size is insignificant in determining fertilizer use. This is also true in Khanewal (Table 6.10).

We have seen in our discussion(Section 4.2Chapter 4)that a number of arguments may be suggested to explain the greater intensity of use of the traditional inputs by the small farmers. Briefly, these arguments are related to the differences in the quality of soil (Khusro (1974);Sen (1964)), labour market duality (Sen (1964)) and attitude towards risk (Srinivasan (1972);Bliss and Stern (1980)). Here , however, we have to explain why size is not an important factor in determining fertilizer use per acre in Khunda, Chak and Khanewal. In Chak the distribution of land is relatively equal so that the comparatively large farmers have no special advantages leading to greater intensity of input use. (This is confirmed also by the results presented in Chapter 4 where we saw that, of all the villages, output per acre in Chak is the closest to being invariant with size). In Khanewal large farmers have good access to a vast network of extension services set up by the Government. This offsets some of the inherent disadvantages that lower the intensity of input use on the large farms. In Khunda the insignificance of size may be due to the fact that,as yet,very few farmers use fertilizers (see Table 6.7). Once the impact of fertilizer use has been established in that region the inverse relationship may assert itself.

It will be noted that the size factor is unimportant in different ways in Jatli and Mehdiabad. This may be explained in terms of access to irrigation. Fertilizer use is crucially correlated with irrigation. In Jatli the survival of small farms depends importantly on access to irrigation. Typically, therefore, a greater proportion of the farm land is irrigated compared to the large farms. This factor, in conjunction with the small farms' ability to use more labour (fertilizer application increases labour activities on the farm such as the application itself, weeding and harvesting), results in a different value for the coefficient compared to Mehdiabad where, although large farms may be at a disadvantage regarding the intensity of labour use, they have better access to canal irrigation compared to the small farms (see Table 6.9) and hence apply more fertilizer per acre.

Pure share-cropping tenancy is important only in Jatli in determining fertilizer use. The coefficient value indicates that share-croppers have a lower intercept compared to the owner-cultivators. These results indicate that share-croppers are at a disadvantage where fertilizer use is concerned. This is confirmed by the value of the coefficient for owner-cum-share-croppers. It is interesting to note, however, that farmers in this tenurial category use inputs more intensively compared to pure share-croppers. This may be explained by their lower risk aversion due to ownership of land (which is less risky compared to rights in a share-cropping contract). It will be seen that in Chak also owner-cum-share-croppers have a lower intercept compared to pure owner-cultivators. However, pure share-croppers seem to be at no particular disadvantage. An explanation for this may be that land-owners of pure share-croppers in the village are typically large land-owners who cultivate most of their owned land themselves so that they exercise regular and strict supervision. They may also share costs with the tenants. Owner-cum-share-croppers, on the other hand, rent in land from landowners who usually own small plots of land and who either live away or work outside the village so that their supervision may be lax. This may explain the result that owner-cum-share-croppers use fertilizer less intensively (on their total holdings) compared to pure share-croppers and owner-cultivators

The impact of tenure on fertilizer use in Khanewal is quite interesting. There appears to be no difference in use between share-croppers from whom landowners have reclaimed land and those whose total farm size is unchanged. However, compared to thesetwo tenurial categories, both owner-cultivators without change in farm area as well as owner-cultivators who have reclaimed land, use fertilizers more intensively. Further, owner-cultivators who have reclaimed land from share-croppers have a higher intercept compared to the others. This result supports the view that some landowners may resume land from their tenants if the latter cannot adopt modern methods of cultivation. In the course of our survey in Khanewal, a number of landowners who had recently resumed land from share-croppers informed us that they did so not because the share-croppers used the new inputs less intensively than other cultivators (owners or share-croppers) but because the landowners had decided to cultivate the land themselves with hired managers who recommend both higher doses of fertilizers and new varieties of fertilizers. They expected to increase their output considerably by switching over to the new methods of cultivation. (The choice of the tenant from whom land is to be reclaimed appears to depend on the pattern of fragmentation. Usually landowners reclaim land from tenants whose plots are adjacent to that part of the landowner's holdings that they had been cultivating themselves with the old technology.

It is interesting to note that fixed-rent tenants, whether they are pure tenants or part owners, use fertilizer as intensively as pure owner-cultivators. This evidence supports the theoretical conclusions of Chapter 5 in which it is argued that this tenurial category allocates resources in the same manner as owner-cultivators.

In Mehdiabad cultivating households with migrant members who send back remittances, use fertilizers more intensively compared to others.

In Jatli remittances are an important determinant of fertilizer use for owner-cum-share-cropper category only. We shall discuss these results further in Chapter 7.

It can be seen in Table 6.10 that in Khanewal regular supervision by the landlord of the share-cropped land raises the intensity of fertilizer use on the farm.

Tractors

Our discussion of the impact of the explanatory variables on tractor use will be presented using evidence from Jatli and Mehdiabad. The three tenurial categories observed in the barani villages are found in Jatli while all five tenurial categories exist in Mehdiabad. The results are presented in Table 6.8. For Khanewal the results of tractor use are presented in Table 6.10. It must be remembered that in Jatli and Mehdiabad the dependent variable is the proportion of total acreage under tractor cultivation while in Table 6.10 for Khanewal, the dependent variable is the number of tractor ploughings for wheat.

In Table 6.8 we see that size of holding is inversely related to tractor use in both Jatli and Mehdiabad. This is a surprising result since greater ownership of tractors by large farms is likely to encourage greater intensity of use as well. (This may be explained, in part, by our measure of tractor use. It is possible that if intensity of tractor use is measured in terms of the number of ploughings of a field (as in Khanewal) we are likely to observe that large farms use tractors more intensively compared to small farms. Further, the value of the coefficient is greater in Jatli as compared to Mehdiabad indicating the better functioning of the market for tractor services in Jatli. In Khanewal (Table 6.10) the intensity of tractor use on wheat increases with the size of holding. This is explained partly by the greater incidence of tractor ownership amongst the big landowners in Khanewal which facilititates intensity of use.

In both Jatli and Mehdiabad pure share-croppers use tractors less intensively compared to owner-cultivators. In Jatli owner-cum-share-croppers also use tractors less intensively than owner-cultivators but more than pure share-croppers. Both these results are consistent with our hypotheses regarding the impact of tenancy on input use discussed in Section 6.2. It is interesting to note, however, that in Mehdiabad fixed-rent tenants, whether pure or part owners, use tractors less intensively compared to pure owner-cultivators. This suggests that in Mehdiabad tenancy disincentives concerning tractor use are explained not in terms of the nature of tenancy contracts (i.e. whether it is fixed rent or share-cropping tenancy) but by the pattern of ownership of tractors and the nature of markets for tractor services. In Mehdiabad we noted that tractors are owned mainly by owner-cultivators and hiring in of tractors is less common than in other villages. This argument applies to Khanewal also where due to the pattern of ownership, owner-cultivators use tractors more intensively compared to share-croppers. Amongst the owner-cultivators, those who have recently reclaimed land from share-croppers use tractors more intensively compared to all other tenurial categories.

Our results indicate that in Jatli cultivating households with migrant members use tractors more intensively compared to others (see Table 6.8). This is an interesting result and will be discussed further in Chapter 7, in the context of an anlysis of the relationship between farm mechanisation and migration.

Tube-wells

Amongst our four villages tube-well irrigation is available only in Mehdiabad. (In Jatli and in Khunda the costs of reaching subsoil water are very high both because of the depth at which water is found and because the soil is rocky, while in Chak subsoil water is saline). Results of tests of hypotheses regarding tube-well irrigation in Mehdiabad are presented in Table 6.9. Amongst our sample of farmers in Khanewal, tube-well irrigation is widespread (see Table 6.4.e.) Result of the tests in Khanewal are presented in Table 6.10.

In Mehdiabad neither size nor tenure are important in determining the 'vaars' of tube-well irrigations on the farm. This is an important result reflecting the efficiency with which markets for tube-well water function.

In Khanewal (Table 6.10) owner-cultivators use tube-well irrigation more intensively compared to share-croppers. Further, share-croppers with effective supervision use tube-well irrigation more intensively than others. Finally, sharing of costs of tube-well irrigation increases the number of irrigations on the share-cropped farm. Thus all our results on tube-well irrigation are consistent with the theory concerning share-cropping tenancy. Further, the development of effective markets for tube-well water implies that differences in use across farms are determined by the disincentive of tenure rather than the problems of access.

Canal irrigation

Finally, our tests of hypotheses concerning canal irrigation are presented in Table 6.9 for Mehdiabad and in Table 6.10 for Khanewal.

In Mehdiabad size and tenancy are positively correlated with the number of canal irrigations. This result implies that in the annual cropping season large farms and tenants (both share-croppers and fixed-rent tenants) irrigate their land more often than small owner-cultivators. Amongst the tenants fixed-rent tenants irrigate more often compared to share-croppers. Further, fixed-rent tenants who are part owners, irrigate more often than pure fixed-rent tenants.

Mehdiabad is an old canal colony village where land settlement under the British re-affirmed the traditional inegalitarian structures. The provision of canal water in the village reflects this structure. Thus large landowners have better access to irrigation because their farms are located close to the 'rajwah' (the irrigation channel). Further, they are in a better position to manouvre the canal 'patwari' in the allocation of water because as large landowners they extend patronage to petty Government servants. This advantage of better access to water is put into effect not only for self-cultivation (captured by the positive correlation between the size of holding and canal irrigation) but also while leasing out land on tenancy. Large landowners can improve their bargaining position vis-a-vis the tenants by offering greater access to irrigation which lowers the risk of crop failure. Access may also be determined by the degree of risk associated with the tenurial contract. Fixed rent tenants who bear greater risks of cultivation comparedto share-croppers are offered better access to irrigation. Further fixed-rent tenants who partly own the land they cultivate, have better access to irrigation than pure fixed-rent tenants.

In Khanewal (Table 6.10) neither size nor tenancy are significant in determining the intensity of canal irrigation on the farm. An important explanation for this is that Khanewal sub-division is richly endowed with canal water. A major canal, lower Bari Doab, distributes the water of river Ravi through an elaborate grid of 'rajwahs'. Thus farms do not have any special advantage of location as in Mehdiabad. In the south-eastern reaches of Khanewal sub-division the quantity of water in the canal declines substantially but this affects all farms regardless of tenure.

Table 6.7 Estimated values of the coefficients of determinants of the intensity of fertilizer use in the four villages

Dependent variable 1/ : value of fertilizer used per acre for all crops

(linear form)

Village / Ind.Variables	Jatli	Khunda	Mehdiabad	Chak
Constant	35.23	0.02	87.39	80.14
HOLDCULT (H)	-0.53*	-0.0004	0.21**	0.11
Dummy for share-cropping tenancy (T_2)	-31.81**	0.08	-13.90	-13.38
Dummy for fixed-rent tenancy (T_3)	-	-	0.24	4.25
Dummy for owner-cum-share-cropping tenancy (T_4)	-16.47*	-0.002	-17.00	-33.22**
Dummy for owner-cum fixed-rent tenancy (T_5)	-	-	10.59	10.23
Dummy for migration (T_6)	-1.24	-0.007	33.81**	2.97
Dummy for share-cropping/migration (T_{26})	0.62	-0.07	-	-36.65
Dummy for fixed-rent tenancy/migration (T_{36})	-	-	-	-
Dummy for owner-cum-share-cropper/migration (T_{46})	22.17**	-0.01	25.71	54.78
Dummy for owner-cum-fixed-rent tenancy/migration (T_{56})	-	-	-	-25.10
R^2	0.25*	0.003	0.10	0.05

1/. The estimates are obtained by using equation (3)discussed in Section 6.3.2 in the text. F-values and R^2 values for the equation in each village are given in Tables 6.11 to 6.14 in the Appendix.

* Indicates significance at 5 percent level while

** indicates significance at 10 percent level.

Table 6.8 Estimated values of the coefficients of the determinants of the intensity of tractor use in Jatli and Mehdiabad.

Dependent variable 1/. Acreage ploughed with tractors as a percentage of total farm acreage

(linear form)

Village / Ind.Variable 2/	Jatli	Mehdiabad
Constant	2.08	1.89
HOLDCULT	-0.55*	-0.01*
T2	-1.73**	-1.70*
T3	-	-1.66*
T4	-1.01*	0.38
T5	-	-1.13*
T6	0.36**	0.56
T26	0.29	-
T36	-	-
T46	0.43	-0.99
T56	-	-
R^2	0.22*	0.39*

1/ The estimates are obtained by using equation (3) discussed in Section 6.3.2 in the text. F-values and R^2 values for the equation in each village are given in Tables 6.11 and 6.12 in the Appendix.

2/ For definition of variables see Table 6.7

* indicates significance at 5 percent level while
** indicates significance at 10 percent level.

Table 6.9 Estimated values of the coefficients of the determinants of the intensity of tube-well and canal irrigation in Mehdiabad[1]

Dependent variable : Number of irrigations on the farm

Input Ind.Variables[2]	Tube-well irrigations	Canal irrigations
Constant	13.99	-3.69
HOLDCULT	-0.02	0.32*
T2	7.09	12.72*
T3	-4.37	18.09*
T4	2.16	5.99
T5	-1.55	22.03*
T6	1.39	-
T26	-	-
T36	-	-
T46	-3.45	-
T56	-	-
R^2	0.05	0.42*

1/ The estimates are obtained by using equation (3) discussed in Section 6.3.2 in the text. F-values and R^2 values for the equation are given in Table 6.12 in the Appendix.

2/ For definition of variables see Table 6.7.

* indicates significance at 5 percent level while

** indicates significance at 10% level.

Table 6.10 Estimated values of the coefficients of the determinants of the intensity of use of modern inputs in Khanewal 1/

(linear form)

Dependent Variables / Ind.variables	Fertilizer use per acre	Tractor ploughings	Tube-well irrigation	canal irrigations
Constant	55.51	0.71	-0.05	6.29
HOLDCULT	-0.09	0.02*	0.001	0.004
T2	13.79	0.08	0.03	1.19
T3	40.55**	1.45**	3.55*	-1.56
T4	65.30*	1.66**	2.92*	-0.56
T5	22.13**	0.62	1.05**	-
T6	27.53	-0.23	2.91*	-
R^2	0.12*	0.28*	0.18*	0.04

1/ The estimates are obtained by using equation (4) discussed in Section 6.3.2 in the text. F-values and R^2 values are given in Table 6.15 in the Appendix.

2/ For the definition of variables see text on pp.270,271.

* indicate significance at 5 percent level while

** indicate significance at 10 percent level.

Section 6.4 Conclusions

The analysis presented in this Chapter suggests the following broad conclusions about the relationships between size, tenure and input use.

The empirical evidence suggests that size of holding is statistically significant in determining fertilizer use and the coefficient has a negative sign in Jatli, implying that small farmers use fertilizers more intensively than large farmers, and a positive sign in Khunda implying more intensive use by large farmers. Further, size appears to be insignificant in determining the use of tube-well irrigation. The impact of size on canal irrigation is ambiguous. In Mehdiabad size is significant in determining fertilizer use and has a positive sign while in Khanewal it is insignificant. Finally, when tractor use is properly defined (in terms of the number of ploughings), the evidence suggests that large farmers use tractors more intensively compared to the small farmers.

Only the first three inputs raise farm productivity unambiguously. Tractor ploughing may increase output provided cropping intensity is raised and that does not always follow (Binswanger (1977)). Thus except in Mehdiabed (where large farmers use more fertilizer and canal irrigation) there is little evidence to suggest that the use of new inputs associated with 'green revolution' technology may reverse the traditional inverse relationship between size and productivity.

Our evidence suggests that tenancy is important in determining the use of modern inputs. Share-cropping tenants use modern inputs less intensively than owner-cultivators and fixed-share tenants. However evidence from Khanewal suggests that cost-sharing arrangements and regular supervision by landowners can lower the disincentives of investing in new inputs. In Khanewal empirical evidence supports the view that landowners reclaim land from share-croppers because they wish to use modern inputs more intensively than their share-cropping tenants. It appears, therefore, that tenurial contracts may be influenced in an important way by the inputs associated with 'Green Revolution' technology.

Thus our evidence suggests that limited adjustments may take place in input markets to loosen the constraints imposed by imperfections in rural capital markets on input use. Ownership of land improves credit worthiness of all farmers. Large farms borrow from formal institutions such as banks, while small farmers borrow from village shopkeepers, the 'arhtia' and the 'biratheri'. However, tenants who do not own land at all have very low credit rating so that unless the landowner agrees to underwrite the loans taken by his tenant, it may be impossible for the tenant to borrow. The landowner then has the choice of either underwriting loans and making cost sharing arrangements with his tenants, along with regular supervision, to ensure appropriate intensity of input use or he may reclaim land for self-cultivation and use the modern inputs as intensively as the technology requires.

Finally, the relationship between migration and the use of input appears to be complicated. We have presented a first look at the issues. Our results indicate a positive correlation between fertilizer use and migration. This suggests that remittances from migration may be an alternative to borrowing in the village capital markets for purchase of the new inputs. However, detailed discussion of theory and evidence is required before suggesting this conclusion. We shall attend to this task in the next chapter.

APPENDIX TO CHAPTER 6

Table 6.11 Regression estimates of equation (3) in Jatli (see text section 6.3.2.)

(linear form)

Dependent Variables / Ind. variables 1/	Value of fertilizer used per acre	Area ploughed by tractor as percentage of all farm area
HOLDCULT	-0.53*	-0.55*
	(3.36) 2/	(13.49)
T2	-31.81**	-1.73**
	(1.81)	(1.99)
T4	-16.47*	-0.01*
	(3.14)	(4.40)
T6	-1.24	0.36
	(0.05)	(1.60)
T26	0.62	0.29
	(0.00)	(0.02)
T46	22.17**	0.43
	(1.81)	(0.18)
Constant	35.23	2.08
R^2	0.25	0.22
F	3.57*	3.79*
S.E.	23.03	1.71
N	171	171

1/ For definition of variables see Table 6.7.

2/ Figures in brackets are F-values.

* indicates significance at 5 percent level while
** indicates significance at 10 percent level.

Table 6.12 Regression estimates of equation (3) in Mehdiabad (see text section 6.3.2.)

(linear form)

Dependent variables / Ind. variables 1/	Value of fertilizer used per acre	Area ploughed by tractors as a percentage of farm area	Number of tube-well irrigations on the farm	Number of canal irrigation on the farm
HOLDCULT	0.21**	-0.01*	-0.02	0.32*
	(1.74)2	(3.25)	(0.08)	(24.23)**
T2	-13.90	-1.70*	7.09	12.72*
	(1.10)	(17.55)	(0.97)	(5.44)
T3	0.24	-1.66*	-4.37	18.09*
	(0.00)	(19.31)	(0.43)	(12.84)
T4	-17.00	0.38	2.16	5.99
	(0.90)	(0.47)	(0.05)	(0.73)
T5	(10.59)	-1.13*	-1.55	22.03*
	(0.43)	(5.28)	(0.03)	(11.14)
T6	33.81**	0.56	1.39	
	(1.94)	(0.42)	(0.01)	
T46	25.71	-0.99	-3.45	
	(0.27)	(0.43)	(0.02)	
Constant	87.39	1.89	13.99	-3.69
R^2	0.10	0.39	0.05	0.42
F	0.94	5.65*	0.43	9.28*
S.E.	37.71	1.15	20.48	15.72
N	70	70	70	70

1/ For defition of variables see Table 6.7

2/ Figures in brackets are F-values.

* indicates significance at 5 percent level while
** indicates significance at 10 percent level.

Table 6.13 Regression estimate of equation(3) in Khunda (see text section 6.3.2.)

(linear form)

Dependent variable / Ind.variables [1]	Value of fertilizer used per acre
HOLDCULT	-0.0004 (0.048)[2]
T2	0.08 (0.25)
T4	-0.002 (0.00)
T6	-0.007 (0.001)
T26	-0.07 (0.05)
T46	-0.01 (0.00)
Constant	0.02
R^2	0.003
F	0.10
S.E.	0.75
N.	194

1/ For definition of variables see Table 6.7

2/ Figures in brackets are F-values

Table 6.14 Regression estimates of equation (3) in Chak (see text Section 6.3.2)

Dependent variable Ind.variable 1/	Value of fertilizer used per acre
HOLDCULT	0.11 (0.03) 2/
T2	-13.38 (0.38)
T3	4.25 (0.01)
T4	33.22** (1.89)
T5	10.23 (0.35)
T6	2.97 (0.05)
T56	-25.10 (0.48)
T26	-36.65 (0.91)
T46	54.78 (0.91)
Constant	80.14
R^2	0.05
F	0.63
S.E.	50.64
N.	110

1/ For definition of variables see Table 6.7.

2/ Figures in brackets are F-values.

** indicates significance at 10 percent level

Table 6.15 Regression estimates of equation (4) in Khanewal (see text Section 6.3.2)

(linear form)

Dependent variables / Ind. variables 1/	Number of tube-well irrigations on the farm	Value of fertilizer used on the farm	Number of tractor ploughings on the farm	Number of canal irrigations on the farm
HOLDCULT	0.001	-0.09	0.02*	0.004
	(0.03)[2]	(0.57)	(15.37)	(0.10)
T2	0.03	13.79	0.08	1.19
	(0.00)	(0.38)	(0.004)	(0.67)
T3	3.55*	40.55**	1.45**	-1.56
	(6.82)	(1.14)	(2.18)	(0.91)
T4	2.92*	65.30	1.66**	-0.56
	(4.38)	(2.87)	(2.57)	(0.10)
T5	1.05	(22.13)**	0.62	
	(1.29)	(1.49)	(0.42)	
T6	2.91*	27.53		
	(6.81)	(0.69)		
Constant	-0.05	55.51	0.71	6.29
R^2	0.18	0.17	0.28	0.04
F	2.86*	2.82*	5.01*	0.85
S.E.	2.23	44.44	2.37	5.24
N	85	85	85	85

1/ For definition of variable see page 270 in the text.

2/ Figures in brackets are F-values

* indicates significance at 5 percent level while

** indicates significance at 10 percent level

CHAPTER 7

Migration

Section 7.0. - Introduction

We shall begin with a general discussion of the extent of migration in three of the four villages, i.e. Khunda, Jatli and Chak. Mehdiabad will be omitted from our discussion in this chapter because of the low incidence of migration (only 3 out of the 70 cultivating households reported migrant members in the village). There are several reasons for the low incidence of migration in Mehdiabad. One is that the village is poorly connected to urban centres. Roads connecting the village to the highway leading up to Lyallpur (40 miles away) are unmetaled. Consequently bus journeys take long and the frequency of the service is low. It is worth noting that although the incidence of migration is low amongst the cultivating households, there are a few non-cultivating households in the village (these are shop-keepers, school teachers, landless labourers) who have migrant members (see Naseem (1979). An important explanation for the low incidence of migration amongst cultivating households may be the employment opportunities generated in agricultural activities. We have already noted in Chapter 6 that the intensity of use of the new inputs is quite high in this village. Thus members of both tenant and small ownercultivator households get employment on large farms within the village or in the neighbouring villages (the use of the new inputs is widespread in the whole region).

Our analysis in this chapter will be concerned with household units. A household unit with one or more migrant members will be called HHM and a household without migrant members will be called HHW A migrant will be defined as a person who is considered to be a member of the household in a village but who was not living in the village at the time of the survey. He is usually a family member who lives and works in the town but remits income back to the household. Commuting is important in some of the villages but the problems involved are somewhat different. Thus we shall exclude commuters from our discussion. These issues will be taken up in detail when we discuss the variables relevant to our model of migration.

We shall be concerned only with farming households in the villages. This will ensure consistency with the analysis presented in the previous chapters. Also, it will enable us to comment on models (such as that of Stark, 1975) that argue that migration may be the result of the workings of rural factor markets in developing countries so that there may be a relationship between the choice of techniques in agricultural production and rural-urban migration.

Table 7.1 below gives the distribution of HHM's and HHW's in the three villages, 29% of the total cultivating households in the three villages have one or more migrant members. The incidence of HHM is highest in Jatli followed by Chak and Khunda. Some explanations regarding inter-village differences in migration will be offered in Sections 7.2 and 7.3.

There exists evidence to suggest that although migration among non-farming households (i.e. landless labourers, artisans and shop-keepers) is quite wide-spread in Punjab, its incidence in such households is relatively small compared to the incidence of migration in cultivating households. In a survey of rural labour in Punjab, Eckert (1972) interviewed 384 village households randomly selected from 40 villages and reported that 62% of all migrants belong to cultivating households. The considerably higher incidence of

Table 7.1

Distribution of cultivating households with and without migrant members in Jatli, Khunda and Chak (Number of households)

	Households with migrants. HHM	Households without without migrants HHW	Total households.THH	HHM as a percentage of THH
Khunda	30	164	194	16
Jatli	79	100	171	46
Chak	28	86	110	26
Total	137	350	475	29

migration among farming households is also noted in a survey of village studies in India by Connell et.al. (1974). In a paper based on the data from the villages covered by the Islamabad team, Naseem (1979) reports that 78% of the migrants come from farming households.

The traditional pattern of migration from Jatli and Kunda was for migrant males to join one of the services such as the army and the police. Since the mid-sixties, with the shifting of the Capital from Karachi to Islamabad, other urban job opportunities have also opened up for potential migrants. More recently, however, overseas migration (initially to the U.K. and other European countries but later to the Gulf States) has become quite important. In Jatli there are 27 households with members working overseas. In another village, Mahnder, located in the same sub-division (Gujjar Khan) 24 households reported having members who have migrated overseas.

Most of the migrants remit cash back to the village households. Table 7.2 below shows the number and percentage of households receiving remittances (however small) from migrant members in the three villages[1/]. The pattern of remittances is important for the discussion that will follow in this chapter. It indicates that migrant members continue to maintain strong links with their rural households after migration. This suggests that the relevant unit of analysis in a migration model may be the household rather than the individual migrant (we shall say more on this later).

Table 7.2.

The Pattern of Remittance amongst Households with Migrant Members (HHM) in Kunda, Jatli and Chak

	Number of HHM with remittances	Percentage of all HHM
Khunda	18	60
Jatli	77	98
Chak	24	86
Total	119	87

In the present chapter we shall analyse the broad trends concerning migration. In Section 7.1 we shall discuss the specification of the migration function that we shall estimate in our three villages. The justification for the choice of our unit of observation (which is the

1/. Further details regarding remittances are given in Table 7.11 in Appendix.

cultivating household rather than the individual migrant) will be given. We shall then go on to discuss our hypotheses that specify the relationship between the decision to migrate and the variables that may be important in such a decision.

In Section 7.2 we shall present a migration profile in the three villages. This will be a cursory look at the evidence to get a general idea regarding the appropriateness of the choice of our explanatory variables and whether the 'raw' evidence supports the hypotheses formulated in Section 7.1.

It will be argued that the decision to migrate is a threshold type decision implying a zero-one value for the dependent variable in the migration model. This raises special issues concerning the appropriateness of estimation techniques. In Section 7.3 we shall use probit analysis and the associated maximum likelihood method which yield unbiased and efficient parameter estimators. Some of the specification errors resulting from using the conventional ordinary least squares method will be pointed out. We shall then present our results derived by using the maximum likelihood method. We shall convert the estimated probits to probabilities and thus evaluate the probability of migration for the 'average' household in each village. The concept of the elasticity of the probability of migration with respect to the determinants of the decision to migrate will be introduced and evaluated. Comparisons will be made across villages.

Finally, we shall present our conclusions in Section 7.4.

Section 7.1. A migration function for our villages

We shall first summarise our discussion of migration models presented in Chapter 2, Section 2.4. This discussion will suggest the broad framework within which our empirical investigation of migration in the three villages will take place. We shall then construct a migration function that emphasizes that village-end variables (in a joint household decision making framework) are also important in the household's decision to encourage members to migrate.

Interest in studying rural-urban migration has arisen mostly on account of the concern with the impact that migration is likely to have on the urban labour markets and public services. This concern is reflected in the theoretical models of migration and the subsequent choice of variables in the migration functions empirically estimated.

We argued in Chapter 2 that for a number of reasons this may be an unsatisfactory approach in explaining migration. There is some confusion about the underlying decision making unit, i.e. whether it is the household or the individual. The individual's maximand, underlying such models, is taken to be income rather than utility so that disutility of labour is ignored. In the derived empirical functions emphasis is placed mainly on the urban-end variables in explaining the decision to migrate. This is also undesirable particularly in view of the arguments suggested by Stark (1975). He argues (the model has been discussed in detail in Chapter 2, Section 2.4) that migration results from households' decision to improve welfare by increasing the available food per capita on the family farm when the option exists of adopting a better technology for food production. The successful adoption of modern technology requires a surplus for investment and alternative income opportunities for the dispersion of associated risk. Migration is seen as the result of households' attempt to achieve these twin objectives.

Thus the process of technological innovation implies that village end variables are also important in explaining rural-urban migration. In this section we shall develop a migration function that takes into account the impact of operations in the credit market and farm mechanization on the decision to migrate. We shall also discuss the impact on migration of other more 'traditional' variables such as education, farm income, non-farm rural income, the size of holding and the tenurial status.

The unit of analysis in our migration function is the cultivating household. The assumption is that decisions regarding resource allocation and income distribution are made jointly. This may imply either a paternalistic (which is more plausible) or a democratic decision making procedure. The decisions result in an equal distribution of effort and income across adult males of the household. Further, we shall argue that household's maximand is utility. Thus the disutility from migration in terms of the psychic costs of breaking up the family unit, will be seen to be important in the decision making process.

The dependent variable in our model takes the value 1 if there is a migrant member in the household, 0 otherwise. This poses special problems of estimation which we shall discuss in Section 7.3. The number of households with migrant members in each of the three villages to be analysed are given in Table 7.1.

We shall define a migrant to be a person who is considered to be a member of the household as defined in Chapter 4, but who was non-resident (see Section 7.0) in the village at the time of the survey. Thus members of households who work outside the family farm but return each day, i.e.

commuters, are not considered to be migrants. This definition of migrants is reasonable given that there are, typically, few employment opportunities in the rural areas (apart from peak seasons when the family farm itself may require all the available labour). Thus commuting is not a viable alternative to migration except in villages that are situated near cities and have access to public transport. (For an analysis of commuters see Akram, 1962). Amongst the three villages that we shall study, only Jatli has access to efficient public transport. However, the distance between Jatli and Rawalpindi (the nearest urban job centre) is 25 miles so that daily commuting is likely to be very costly.

The other feature of our definition of the dependent variable is that the migrants continue to be treated as members of the rural household. Thus we shall attempt to identify the rural end variables that are important in the household's decision to maximize welfare through migration.

Our definition of the dependent variable suggests that threshold effects are involved in migration decisions.[1/.] Borrowing the terminology of biochemistry, we are concerned with explaining the important stimuli that cause an event to occur (see Finney 1971). Thus we shall estimate the probability of a household having a migrant member given the strength of the stimuli which will be indicated by the coefficients on the factors influencing the decision to migrate.

We shall next discuss the explanatory variables in our migration function.

1/. A few households in all three villages report more than one migrant member. The maximum number of migrants reported by a household is three.

An important explanatory variable in our model is output per earner in the household (TPRODE), where earners include both resident as well as non-resident adult males of the household. Earlier in this section, we noted that migration by family members may be the result of the declining value of food per family member, (Stark (1975)). Taking total value of farm output as the income generated on the farm, the variable TPRODE measures the income per earner in the household. This is likely to be closely related to the value of food per family earner. We expect the decision to encourage household members to migrate to be negatively correlated with TPRODE.

Implicit in the definition of TPRODE is an important feature of the working of rural labour markets. The implication is that the decisions regarding distribution of income on the farm are taken jointly and are not necessarily related to the marginal contribution that a family member makes to the total family output. Thus TPRODE, rather than the village wage, may be considered the opportunity cost that a household member takes into account while deciding whether or not to migrate. Underlying the definition of TPRODE, therefore, are strong assumptions regarding the working of the rural labour market (see the dicussion in Chapter 4).

Another interpretation of TPRODE suggests that this variable may be positively correlated with the decision to migrate. The importance of job search in urban job markets has been noted in a number of studies (Harris-Todaro, 1970; Fields, 1975). During the period of search, the migrant has to sustain himself. An important source of sustenance may be the migrant's share in output on the family farm. The greater is the value of the share, the longer is the search time that a migrant can spend in the urban labour market to look for jobs with high returns.

Thus the value of TPRODE may be positively related to the decision to migrate. Our empirical test will indicate which of the two effects is stronger.

An important variable in the model that we shall test is the acreage available per earner, HOLDE, in the farming household. In a village environment,HOLDE is likely to be important in determing the perceived social status of the household. Social status may determine the type of job markets that a household is likely to encourage a member to participate in. To the extent that higher values of HOLDE suggest higher status in the village, this may result in a search for only influencial jobs in the cities (e.g. in the elite services). The scarcity of such jobs,relative to the number of aspirants,may lower the probability of getting such jobs and thus may discourage migration. Higher values of HOLDE may discourage migration in another way. When the farm size increases beyond the critical size that can be cultivated by family members, a household hires in labour. (An alternative is to rent out land but this will be discussed later in this section). Supervision now becomes essential. Thus households that have large acreage of land available per adult member, have greater employment opportunities for family members as farm supervisors. This may discourage migration. Small farms with low land-man ratio, on the other hand, may be characterized by surplus labour which may encourage migration [1/].

It has been argued in a number of empirical studies (Greenwood,1971; Hay, 1974; Levy and Wadychi, 1972), that education is a significant variable

---

1/. The inclusion of HOLDE along with TPRODE may result in problems of multicollinearity in the estimation procedure. We shall take up this issue in detail in Section 7.3.

in explaining migration. The main hypothesis regarding the influence of education on migration is that the probability of finding a job in the urban labour markets is raised through education. This may be true regardless of whether or not education results in real differences in skills. For example, employers may use School Certificates to screen applicants. Years of schooling may also represent real and scarce skills and may thus directly result in segmenting labour markets by skills. The influence of technical education on the probability of getting employment (and hence on the decision to migrate) is then likely to depend on the degree of competition in each of these segregated markets.

A problem with including the number of years of schooling as an explanatory variable, is that because of the dimension of time and the degree of planning involved in spending several years in school, the decision to migrate may have been made before the schooling for particular skills and education level begins. This is particularly true in developing countries where, on average, the number of years of schooling required for rural jobs is considerably less than the number of years required for urban jobs, so that schooling may be undertaken specifically to get urban jobs. Thus because of the time dimension, there may be a problem of simultaneity in an equation that 'explains' migration in terms of years of schooling.

In our model we shall include the proportion of the educated to the total number of adult males in the household, STUDE, as an explanatory variable. We expect the value of STUDE to be positively correlated with the decision to migrate.

In the discussions presented in Chapters 3 to 6 we have emphasized the importance of rural credit in agricultural production. The main conclusions may be summarised as follows. In Chapter 3 we presented the evidence regarding operations in credit markets in the four villages. The evidence indicates that most cultivators participate in the credit markets, borrowing funds from sources such as friends/relatives, arhtia/middleman/shop-keeper, landowner, and cooperative societies. We indicated that borrowing was undertaken to meet both consumption and production needs (we discussed some of the difficulties of distinguishing between the two). In Chapter 4 we argued that access to credit is important in determining the use of modern inputs - and therefore productivity - on farms in different size-categories. In Chapter 5, we indicated the importance of borrowing from the landowner in determining productivity on sharecropped farms. In Chapter 6 these arguments were verified by examining the direct evidence on the use of modern inputs in the four villages. We concluded that although arrangements regarding institutional credit appear to favour large farmers, they generally do not use the modern inputs more intensively than small farms. We pointed out some alternative arrangements in terms of factor market linkages, that may facilitate small farmers' 'access' to the new inputs. For example, middlemen who trade in cash crops may extend credit directly in terms of inputs. Also, landowners may extend credit to sharecroppers to encourage use of the modern inputs. We argued that remittances from migrant members of cultivating households may also be important. We have already discussed Stark's model in determining the intensity of input use by small farmers (in detail in Chapter 2, Section 2.7 and in summary early in this section), which emphasizes the importance of migration in the adoption of 'green revolution' technology. It is argued that migration results from small farmers' inability to borrow funds in the rural credit markets to purchase the new inputs. Our evidence presented in Chapters 3 and 6 indicates both that small farmers frequently borrow funds in the rural credit markets and that often they use the new inputs as intensively as the large farmers. Further, the evidence in our four villages (to be presented in Section 7.2) indicates that the incidence of migration is also high amongst small farmers. On the basis of these observations and some assumptions regarding operations in the credit markets we shall argue that there may be a positive relationship between the ability to borrow in the credit market and the incidence of migration.

Let us consider three likely borrowing/repayment schedules in the credit markets in our villages. In one, the household borrows in the lean period and repays at harvest time when household members get casual employment. In this arrangement migration plays no role. In the second arrangement households may borrow large amounts for either purchasing a bulky new input such as a tube-well or a tractor or for marriage/death, and pays back in small installments at harvest time every year for several years. We assume that the amount borrowed is too large to be repayed with the harvest of one year. 1/ If the creditor agrees to this arrangement migration again plays no role. The third arrangement may involve borrowing a large amount and then repaying the loan in small but frequent, say, monthly, instalments. The last arrangement may be attractive to lenders particularly if we allow for risk. Crop output is subject to high risk whereas steady employment in the cities, once it has been secured, generates a small but regular flow of monthly remittances, and may be considered less risky by the lenders. The last arrangement therefore is likely to prevail

1/ This is quite realistic given that in our villages large farmers borrow to purchase tractors or tube-wells and small farmers for marriage/death ceremonies.

because of the relatively strong bargaining position of the lender in the rural credit markets. (During our field survey in Khanewal the majority of small farmers interviewed indicated that remittances from migrant members are important in determining their credit worthiness.) This argument suggests that the migration is likely to be positively correlated with the amount that the household owes to creditors.

Households may borrow also to finance migration. The amounts borrowed may cover more than just the travelling costs. We have mentioned earlier that there may be a long search period involved in finding a job in the urban labour market. Households may have to borrow to sustain the migrant member during this period. This may be another argument for expecting a positive relationship between indebtedness and the decision to migrate.

In our migration function we have included debt owed per earner, DEBTE, in the household as an explanatory variable. We expect it to take a positive sign.

We argued above that given the functioning of the rural credit market, the need for generating cash, either for consumption directly or for investment on the farm, may result in migration to the urban areas. There may exist other sources of non-farm income near the villages. In our three villages, several cultivating households reported resident members who are village shopkeepers. Another frequent source of non-farm income is the rent received from land rented out by the family. (We are distinguishing between income from family farms that are self-cultivated and including it in farm-income and income from rented land and including it in non-farm income.) Some of the larger landowners also reported incomes in the form of interest rates on bank deposits. (The returns on deposits, however, are approximate since most respondents were reluctant to divulge the amounts deposited in the banks). Another important source of income is the employment of resident household members in government services, such as teaching in schools and the irrigation department.

A household may regard remittances by migrant members and non-farm earnings of household members who commute to work, as competing sources for generating cash flows. For example, it is not difficult to envisage a calculus underlying the household decision in which, in equilibrium, the expected marginal return (utility) to the family of investment in establishing a village shop, equals the expected marginal return (utility) from the investment in providing sustenance to a migrant member while he is looking for a job in the urban labour market. For the large farmers a similar calculus may underlie the decision either to deposit money in a bank and getting an interest rate, or to provide higher education to their children who then get urban jobs. Migration, therefore, may be seen as a consequence of the difference between the returns from urban job markets compared to returns from village-end non-farming alternatives.

We argued in Chapter 2, Section 2.2. that efficient sharecropping tenancies require close supervision which is costly in terms of the income opportunities foregone through employment in the urban centres. A cultivating household with large amounts of land may involve all members in looking after family land (some members may work on the family farm as supervisors of hired labour and others as supervisors of share-cropped plots) in order to improve production on owner cultivated as well as sharecropped plots. Alternatively, they may forego some of the returns of sharecropping (in terms of rents received), either by allowing a margin of inefficiency on sharecropped plots because a household member who previously supervised the plot has taken up employment in the city, or by renting out land on fixed rent tenancies (typically rents on fixed-rent tenancies are lower than on sharecropping tenancies, see Chapter 5). An implication of this argument is that when urban employment opportunities exist, households renting out land may be indifferent between inefficient sharecropping contracts and fixed-rent tenancies. Another implication is that, to the extent that rent from land is an important part of the non-farm income of a household, migration and supervision of rented plots may compete for household's labour resources.

In our migration model we have included non-farm income per household earner, NFYE, as an explanatory variable. We expect it to be negatively correlated with the decision to encourage household members to migrate.

The impact of mechanization (particularly tractorization) on the use of labour on farms has been documented in a large number of studies in India. The overall conclusion appears to be that despite the increase in cropping intensity, tractorization results in displacing labour in the sense that the resources invested in purchasing tractors could have been invested in expanding irrigation and in the provision of fertilizers and seeds .This would have resulted in both increased cropping intensity as well as an expansion of rural employment opportunities (Binswanger,1977). In a study of Pakistan's Punjab, McInerny and Donaldson (1975) report that farms using tractors decreased the use of family and permanent hired labour by 59% while casual employment increased by 75%. Earlier, Bose and Clerk (1969) had argued that private net benefits of mechanization in Pakistan may be greater than social net benefits, due to the heavy subsidies on the import of tractors and the loss of permanent farm employment in agriculture.

The foregone employment on the family farm may not be perceived as a private cost if household members can get employment in the urban job centres. Salaam (1976) in a survey of several districts in Central Punjab presents evidence that suggests that unemployed family members tend to migrate to urban areas to seek employment. In the context of our model of migration, this evidence is important and leads us to suggest an interesting hypothesis which can be tested with data from our villages. The first argument (Bose and Clerk 1969), is that mechanization takes place on family farms because private returns are high. The second argument (McInernyand Donaldson, 1975) is that such migration results in the displacement of family labour and finally, Salaam's evidence suggests that the displaced family members migrate to urban job markets to seek employment. Our hypothesis then is that the value of mechanized assets per earner in the household, MECE, is positively related to the decision to migrate.

Finally we have included dummies in the migration equation to determine the influence of different tenurial arrangements on the decision to migrate. The five important categories of tenure are: owner-cultivation, sharecropping, tenancy, sharecropping-cum-owner-cultivation, fixed rent tenancy, fixed rent-cum-owner-cultivation. Each of the four dummy variables included in the equation take the value 1 when the household falls in the relevant tenurial category, 0 otherwise.

We may now write our migration function as:

$$M = f\,(\text{TPRODE, HOLDE, STUDE, DEBTE, NFYE, MECE, D1EN1, DTEN2, DTEN3, DTEN4})$$

where M = 1 if a household has a migrant,

0 otherwise.

TPRODE is the value of farm output per household earner.

HOLDE is the acreage per household earner.

STUDE is the proportion of students to household earners.

MECE is the value of mechanical assets per household earner.

DEBTE is the value of debt owed per household earner.

NFYE is the value of non-farm income per household earner.

DTEN1 = 1 if the household is a sharecropper, 0 otherwise.

DTEN2 = 1 if the household is sharcropper-cum-owner. 0 otherwise.

DTEN3 = 1 if the household is fixed-rent tenant. 0 otherwise.

DTEN4 = 1 if the household is fixed-rent tenant-cum-owner cultivator, 0 otherwise.

The hypotheses discussed in the previous section suggest that the signs of the estimated coefficients on TPRODE, HOLDE and NFYE are expected to be negative, while the signs of the estimated coefficients on STUDE, MECE and DEBTE are expected to be positive.

Section 7.2. - A migration profile in our villages

We shall begin our empirical investigation by presenting a profile of migration in the three villages Khunda, Jatli and Chak within the framework of our migration function (3).

In Table 7.3 below, we have presented a distribution of households with migrants (HMM) and without migrants (HHW) by the three size categories, small, medium and large defined in Charter 3 for each village.

Table 7.3.

Distribution of HHM's and HHW's 1/ by size of holding 2/ in Jatli, Khunda and Chak (Number of farms)

Village	Small Farms			Medium Farms			Large Farms		
	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households
Khunda	4	38	9.5	19	81	19	7	45	14
Jatli	42	60	41	24	25	49	13	15	46
Chak	9	27	25	11	28	28	8	31	21
Total	55	125	44	54	134	40	28	91	31

1/ HHM = households with migrant members, HHW = households without migrant members.

2/ For definition of size-categories see p.133 Chapter 4.

Table 7.3 indicates that most of the migrants from cultivating households in our three villages come from small and medium farm size categories. Taking the two size-categories together, the village incidence of migration is 17,44 and 27 respectively for Khunda, Jatli and Chak. These figures may be compared with those for the large size-category given in the table. It may be noted that except in Jatli the incidence of migration is higher amongst small and medium size farms compared to large farms.

In our migration function (3), we argued that an important criterion for discussing the incidence of migration amongst the cultivation households in our three villages may be the tenurial status of the household. In Table 7.4 below we have presented the distribution of HHM's and HHW's in our three villages by tenurial status.

Table 7.4 Distribution of HHW and HHM[1/] by tenurial status in Jatli, Khunda and Chak

(Number of farms)

Villages	Pure owner-cultivators			Pure sharecropping tenants			Sharecropping-cum-owner-cultivators			Pure fixed-rent tenants			Fixed-rent-cum-owner-cultivators		
	HHM (1)	HHW (2)	HHM as % of total households (3)	HHM (1)	HHW (2)	HHM as % of total households (3)	HHM (1)	HHW (2)	HHM as % of total households (3)	HHM (1)	HHW (2)	HHM as % of total households (3)	HHM (1)	HHW (2)	HHM as % of total households (3)
Khunda	11	32	26	17	118	13	0	0	0	2	14	12	0	0	0
Jatli	72	84	46	1	2	33	0	0	0	6	14	30	0	0	0
Chak	19	63	23	3	6	33	0	2	0	1	5	17	5	10	33
Total	102	179	38	21	126	14	0	2	0	9	33	21	5	10	33

1/. HHM = households with migrant members ; HHW = households without migrant members.

The table shows that most of the HHM's are pure owner-cultivators. This is confirmed in Eckert's (1972) survey of rural labour in the Punjab.

In Tables 7.5a to 7.5d we have presented the distribution of HHM's and HHW's in the three villages by criterion variables, remittances, non-farm incomes, indebtedness and students.

The Tables indicate that a vast majority of migrants send back remittances to the village household in all three villages. Further, the incidence of migration is higher in all villages,except Chak,for households that have no source of non-farm income. Table 7.5c indicates that the incidence of migration is higher amongst households that do not have debts in Kunda and Jatli, while it is higher for households who havehave debtsin Chak. Finally, the incidence of migration is higher amongst households that have at least one member who has been to school,as compared to households that report no schooling.

Finally, in Table 7.6 we report the mean values of the criterion variables, TPRODE, HOLDE, MECE, DEBTE, NFYE discussed in the migration function (3) for HHM's, HHW's and the entire village population for the three villages Khunda, Jatli and Chak.

Table 7.6 presents the empirical evidence which indicates that on average,TPRODE, HOLDE, NFYE and MECE have lower values for HHM's compared to HHW's. This evidence supports our hypotheses concerning the first three criterion variables but not the hypotheses concerning MECE and DEBTE. In Kunda, HHM are more heavily indebted than HHW but not so in Jatli and Chak. Finally the evidence on the proportion of students in the households also appears to confirm our hypothesis in Kunda but not in Chak and Jatli.

Table 7.5.a.

Distribution of households with migrants (HHM) and households without migrants (HHW) by whether or not they receive remittances

(Number of households)

	Without Remittances			With Remittances		
	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households
Khunda	12	159	7	18	5	78
Jatli	2	100	2	77	0	100
Chak	4	84	4.5	24	2	92
Total	18	343	5	119	7	94

Table 7.5.b.

Distribution of households with migrants (HHM) and households without migrants (HHW) by whether or not they have non-farm income

(Number of households)

	Without non-farm income			With non-farm income		
	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households
Khunda	27	125	18	3	39	7
Jatli	68	74	48	11	26	30
Chak	21	78	21	7	8	47
Total	116	277	30	21	73	22

Table 7.5c

Distribution of households with migrants (HHM) and households without migrants (HHW) by whether or not they owe debt.

(Number of households)

	Without debt owed			With debt owed		
	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households
Khunda	8	40	17	22	124	15
Jatli	49	44	53	30	56	35
Chak	16	62	21	12	24	33
Total	73	146	38	64	204	34

Table 7.5d

Distribution of households with migrants (HHM) and households without migrants (HHW) by whether or not they have students.

(Number of households)

	Without Students			With Students		
	HHM	HHW	HHM as % of total households	HHM	HHW	HHM as % of total households
Khunda	18	107	14	12	57	17
Jatli	31	39	44	48	61	44
Chak	3	25	11	25	61	29
Total	52	171	69	85	179	90

Table 7.6

Mean values of criterion variables for HHM and HHW [1] in Khunda, Jatli and Chak.

	HHM	HHW	All households
TPRODE (Rupees)			
Khunda	517.12	1117.83	1024.93.
Jatli	702.15	1196.81	978.50
Chak	1220.33	3085.32	2627.25
HOLDE (acres)			
Khunda	7.98	13.18	12.39
Jatli	2.55	4.24	3.49
Chak	2.43	5.32	4.61
MECE (Rupees)			
Khunda	921.25	1558.14	1459.65
Jatli	179.26	815.58	534.75
Chak	1647.53	1873.52	1818.01
DEBTE (Rupees)			
Khunda	1823.02	1171.47	1272.22
Jatli	443.22	1258.33	898.59
Chak	471.13	776.84	701.75
NFYE (Rupees)			
Khunda	461.21	496.05	490.18
Jatli	83.64	416.55	269.62
Chak	140.65	168.03	161.31
STUDENTS (Numbers)			
Khunda	0.31	0.28	0.28
Jatli	0.58	0.86	0.73
Chak	0.71	0.92	0.86

1/ HHM is households with migrants; HHW is households without migrants.

2/ For definition of criterian variables see pp. 306, 307.

The evidence presented in Table 7.6 is by no means conclusive. These are village averages which may hide several underlying statistical relationships between the variables. More conclusive evidence requires statistical tests of significance. In the next Section we shall discuss the statistical procedures that are appropriate for estimating the influence of the explanatory variables on the decision to migrate as specified in function (3). The results based on such tests will then be used to determine the validity of our hypotheses.

7.3. The Estimation Procedure and the Results

The migration function (3) cannot be estimated sensibly by using the ordinary least squares method. To see this let us consider a model such that

$$M = X\beta + U \qquad (4)$$

where M equals 1 for households with migrant members and 0 otherwise, and X is the vector of variables influencing the decision to migrate.

Clearly, in this model, there are problems of specification. It is hard to imagine a world in which the error term adjusts for the influence of explanatory variables when M = 0. There are other problems as well, since the error term, U, can take only two values, $-\beta X$ and $1-\beta X$ so that U is not distributed independently of the explantory variable. This leads to problems of interpreting the estimated values of the coefficients on the explanatory variables and determining their statistical significance (Kmenta 1971

An alternative procedure is to estimate (3), by using probit analysis which involes the maximum likelihood method. We shall outline the theory of the test procedure basing it on the discussion given in Goldfeld and Quandt (1972).

Let us assume that there exists in nature a random variable, Z_i, for each household i such that if $Z_i \leq X_i \beta$ the household responds by encouraging one or more household members to migrate i.e. $M_i = 1$ and if $Z_i > X_i \beta$ the household has no migrant members i.e. $M_i = 0$. Z_i, therefore, may be interpreted as a threshold variable that determines the critical values of the independent variables at which households respond, by encouraging one or more members to migrate. Now we may write our migration model as follows:

$$M_i = \begin{matrix} 1 \\ 0 \end{matrix} \text{ if } \begin{matrix} Z_1 \leq X_i \beta \\ Z_2 > X_i \beta \end{matrix} \qquad (5)$$

In order to specify the likelihood corresponding to (5) we consider the cumulative distribution of: (a) all households in our sample who have one or more migrant members and (b) all households who do not have migrant members. These may be written as:

$$\Pr (M_i = 1 \mid X_i \beta) = \Pr (Z_i \leq X_i\beta) = \int_{-\infty}^{X_i \beta} f(Z)\, dZ = F(X_i \beta) \qquad \text{(a)}$$

$$\Pr (M_i = 0 \mid X_i \beta) = \Pr (Z_i > X_i\beta) = \int_{\beta}^{\infty} f(Z)\, d Z = (1 - F(X_i\beta)) \qquad \text{(b)}$$

Taking (a) and (b) together, the likelihood function may be written as:

$$L = \prod_{M_i=1} F(X_i\beta) \prod_{M_i=0} \left[1 - F(X_i\beta) \right] \qquad (6)$$

The choice of the method for estimating the vector β depends on the distribution we assume for z in (6). In probit analysis, z is assumed to be normally distributed, while in logit analysis it is assumed to have a $sech^2$ distribution. Finney (1971) has argued that in practice there is very little difference in the two methods regarding the estimated values of the coefficients on the explanatory variables. We shall, therefore, assume a normal distribution for z yielding a probit model which we estimate by using maximum likelihood. Maximum likelihood estimates of the coefficients on the explanatory variables are asymptotically consistent, efficient and normally distributed (Kmenta, 1971).

In the next section we shall present results of the migration function (3) using the probit model. (We also estimated the migration function using the ordinary least squares method. The results are reported in Table 7.12 in the appendix).

Results

Results based on the probit analysis of the migration function (3) are presented in Tables 7.7 to 7.9 for Khunda, Jatli and Chak respectively. An important result to note in the three tables, is the reported values of likelihood ratios and the associated χ^2 values. The value of the ratio enables us to test the null hypothesis that the explanatory variables are statistically insignificant in explaining the decision to migrate. The numerator of the ratio consists of the maximum value of the likelihood function (6), obtained when the coefficients on all the explanatory variables in (3) are restricted to equal zero, while in the denominator the maximum value of (6) is obtained without any restrictions on the coefficients. For large samples −2 log likelihood ratio has χ^2 distribution with K degrees of freedom, when K is the number of restrictions imposed on (6). Thus in Khunda (Table 7.7), the χ^2 value indicates that the probability of obtaining a value at least as great as the observed value of -2 log likelihood ratio (which is 22.27 in the village), under the null hypothesis that all the explanatory variables are insignificant, is 0.002. Thus we may safely reject the null hypothesis. Applying similar reasoning we may reject the null hypothesis implying insignificance of the explanatory variables in Jatli (Table 7.8) since the χ^2 value in this village is 0.0001 and in Chak (Table 7.9) since the χ^2 value is 0.001.

To comment on the statistical significance of individual variables in the migration function, we use the usual procedure of comparing the computed t-statistic of the coefficient with the critical value given in the standard tables. Thus in Khunda (Table 7.7), TPRODE, DEBTE, MECE and DTEN1 are significant at 5% level while NFYE and HOLDE are significant at 10% level. The signs of the explanatory variables are in accord with our hypothesis summarised in Section 7.1. p. 307. A result to note (and one for which we presented no a priori arguments) is that in Khunda, the dummy for sharecropping tenancy appears to be negatively correlated with the decision to migrate. Further, MECE, and HOLDE appear to be insignificant in determining the decision to migrate. We shall comment on these results again later.

In Jatli (Table 7.8) TPRODE and NFYE are significant at 5% level while DEBTE is significant at 10% level. The signs of these three variables are in accord with our hypotheses. Finally, in Chak, (Table 7.9) TPRODE and MECE are significant at 5% level while DEBTE and HOLDE are significant at 10% level. The remaining variables are insignificant. The signs of the significant variables, again, confirm the hypotheses presented in Section 7.1. Further discussion of the results in both villages will be taken up later in this Section.

Table 7.7.

Estimated values of the coefficients on the variables explaining migration decisions in Khunda using Probit analysis.

Dependent variable M_i = 1 if a household has a migrant member,

0 otherwise.

Explanatory variables [1]	Coefficient value	t - Statistic
TPRODE	-0.001	2.5*
STUDE	-0.04	0.15
DEBTE	0.001	1.98*
NFYE	-0.001	1.59 **
MECE	0.000	2.78*
HOLDE	-0.03	1.50 **
DTEN1	-0.46	1.70*
CONSTANT	0.13	0.33
-2 log likelihood ratio	22.27	-
χ^2 (upper tail) [2]	0.002	-
Degrees of freedom	7	-
Number of households	194	-

1. For definition of variables see pp. 306, 307.

2. The tabled χ^2 is the probability under the null hypothesis (that all coefficients on the explanatory variables are zero) of obtaining a log likelihood ratio at least as large as observed here.

* indicates significance at 5% level while ** indicates significance at 10% level.

Table 7.8

Estimated values of the coefficients on variables explaining migration decisions in Jatli using Probit analysis.

Dependent variable: M_i = 1 if a household has a migrant member, 0 otherwise.

Explanatory variables [1]	Coefficient value	t -statistic
TPRODE	-0.0004	2.19*
STUDE	-0.15	1.19
DEBTE	0.0005	1.59**
NFYE	-0.00064	2.56*
MECE	0.00003	0.56
HOLDE	0.01	0.18
DTEN1	0.11	0.12
CONSTANT	0.11	0.34
-2 log likelihood ratio	31.46	-
χ^2 (upper tail) [2]	0.0001	-
Degrees of freedom	7	-
Number of households	179	-

1. For definition of variables see pp. 306, 307.
2. The tabled χ^2 is the probability, under the null hypothesis (that all coefficients on the explanatory variables are zero), of obtaining a log likelihood ratio at least as large as observed here.

* indicates significance at 5% level, while ** indicates significance at 10% level.

Table 7.9

Estimated values of the coefficients on variables explaining migration decisions in Chak using Probit analysis.

Dependent variable: M_i = 1 if a household has a migrant member,

0 otherwise.

Explanatory variables 1/	Coefficient values	t - Statistic
TPRODE	-0.0004	2.12*
STUDE	0.004	0.02
DEBTE	0.0009	1.52 **
NFYE	-0.00001	0.02
MECE	0.00006	1.78*
HOLDE	-0.12	1.24**
DTEN1	0.50	0.94
DTEN2	-3.17	0.47
DTEN4	0.57	1.19
CONSTANT	-0.25	0.64
-2 log likelihood ratio	29.41	-
χ^2 (upper tail)[2]	0.001	-
Degrees of freedom	9	-
Number of households	110	-

1 For definition of variables see pp. 306, 307.

2 The tabled χ^2 is the probability under the null hypothesis (that all coefficients on the explanatory variables are zero) of obtaining a log likelihood ratio at least as large as observed here.

* indicates significance at 5% level, while ** indicates significance at 10% level.

We mentioned earlier (Section 7.1) that HOLDE may be correlated with TPRODE and this may affect our estimates of the coefficients on the explanatory variables. In our three villages Khunda, Jatli and Chak, the correlation coefficient between HOLDE and TPRODE takes the values 0.61, 0.54 and 0.37 respectively. This indicates that in Khunda, at least, there may be problems of multicollinearity. To check this, we estimated our migration function without HOLDE. In none of the villages does this affect, in any important way, the coefficient values on the remaining explanatory variables. Its inclusion, on the other hand, improves the values of the loglikelihood ratios in Khunda and Chak.

In probit analysis, the maximum likelihood estimate of the coefficients on the explanatory variables determine the value of $\hat{z}$, which is the estimated threshold factor in the household's decision to migrate. $\hat{z}$ is also called the probit. The value of $\hat{z}$ may be used to evaluate $\hat{P}$ which is the estimated probability that a household has a migrant member. The relationship between $\hat{z}$ and $\hat{p}$ is non linear (it is argued to be S-shaped so that the probability of migration approaches the extreme values of 0 and 1 asymptotically. (Finney, 1971, also see below.) The estimated values of the coefficients given in Tables 7.7 to 7.9 enable us to evaluate $\hat{z}$ and from these values we can evaluate $\hat{P}$ using the standard Probit-Probability tables (Table IX in Fisher and Yates, 1964). We have presented the values of $\hat{P}$ for the three villages in Table 7.10.

The marginal probabilities giving the change in P, the probability of migration for a unit change in an explanatory variable, may be obtained by evaluating the partial derivatives of the estimated probit equation, i.e.

$$\frac{\partial P}{\partial X_j} = \left[\frac{1}{2\Pi} \exp - \frac{(z - \beta X)^2}{2} \right] \frac{\partial z}{\partial X_j}$$

Table 7.10 Elasticities of the probability of migration with respect to the explanatory variables in Khunda, Jatli and Chak

Villages / Variables	Khunda	Jatli	Chak
Proportion of migrants	0.155	0.441	0.23
$\hat{P}$	0.319 (0.178)[1/]	0.455	0.214
ηTPRODE	-1.15 (-2.06)	-0.34	-1.44
ηHOLDE	-0.418 (-0.740)	-	-0.757
ηDEBTE	1.43 (2.56)	0.392	0.864
ηNFYE	-0.551 (-0.987)	-0.151	-
ηMECE	0.164 (0.294)	-	0.149

1/. Figures in brackets are the probabilities for share-croppers in Khunda.

$\hat{P}$ is the probability that the average household in the three villages has a migrant member

ηTPRODE, ηHOLDE, ηDEBTE, ηNFYE, and ηMECE are elasticities of the probability of migration with respect to, respectively, total value of output per household earner, total acreage per earner, total debt owed per earner, total non-farm income per earner, and total value of mechanical assets on the farm per earner.

The expression in brackets is derived from the assumption of normal distribution of the error term $U = Z - \beta X$. The whole expression indicates that there is a non-linear relationship between P, the probability of having a migrant, and Z, the probit. This implies that the effect of a unit change in an explanatory variable depends not only on that variable but also on the other variables in the function. (Hay, 1974).

An implication of the expression for $\frac{\partial P}{\partial X_j}$ for our villages is that probabilities of migration can be evaluated for groups of individuals that have common characteristics. Different regimes may be constructed within each village on the basis of the significant variables reported in Tables 7.7 to 7.9. Probabilities of migration may then be evaluated for the representative households within each regime.

The expression for $\frac{\partial P}{\partial X_j}$ may be used also for determining elasticity of the probability to migrate with respect to a variable X_j. Elasticity may be defined as:

$$\eta = \frac{\partial P}{\partial X_j} \frac{\bar{X}_j}{P}$$

For our villages we can evaluate $\frac{\partial P}{\partial X_j}$ and P from Tables 7.7 to 7.9 and from standard probit-probability tables given in Finney (1971). $\bar{X}_j$ may be obtained from table 7.6 given in Section 7.2. Clearly, elasticities are evaluated for the 'representative' households in each village. Elasticities at the disaggregated level of specific groups within a village (groups being defined by different regimes as indicated above) may be obtained by estimating the migration function for each group.

In Table 7.10 we have reported the elasticities of the probability of migrates of the 'representative' household with respect to the statistically significant variables in each village. The first row in the table gives the proportion of migrants in each village, the second row gives the probability of migration for the 'representative' households in each village. The subsequent rows give elasticities of the probability of the 'representative' household's migration with respect to, respectively, TPRODE, HOLDE, DEBTE, NFYE and MECE. We noted in Table 7.7 that the dummy for sharecropping tenancy inKhunda is significant. In Khunda, therefore, we have also reported the elasticities when the 'representative' household is a share-cropping tenant.

Table 7.10 indicates that the probability of migration is highest in Jatli followed by Khunda and Chak. This confirms the general impressions formed by informal discussions in the villages(and mentioned in our descriptions of the villages in Chapter 1). Both Khunda and Jatli have a long tradition of households having members with employment in the military and police service. In addition, Jatli has very good access to the national highway and public transport which gives the village an advantage in migration.

Taking elasticities with respect to the significant variables in each village, we can see that a 10 percent change in TPRODE changes the probability of migration by about 12 percent in Khunda, 3 percent in Jatli and 14 percent in Chak. Further, in Khunda, if the representative household is a sharecropping tenant, probability of migration is changed by 21 percent. An alternative way of interpreting elasticities is to evaluate the value by which the proportion of migrants in a village is likely to change. For example, in Jatli, 10% increase in TPRODE is likely to lower the proportion of migrants from 0.441 to 0.428. Thus the elasticity of the probability of migration with respect to TPRODE is most sensitive in Chak, comparatively less sensitive in Khunda and least sensitive in Jatli.

The pattern of the sensitivity of migration with respect to DEBTE across the three villages is similar to that of TPRODE.As we argued in our hypotheses,this may be interpreted as indicative of the working of rural credit markets. In all three villages, lenders may consider potential remittances from migrant members of a household as a safe collateral while making decisions about extending credit. The elasticity values may indicate the relative importance of this factor in credit markets in the three villages.

In terms of our hypothesis that establishes the relationship between the decision to migrate and acreage per earner of the household, the greater sensitivity of the probability elasticities with respect to HOLDE in Chak compared to Khunda,may be interpreted as indicative of the importance, in migration, of the probability of finding urban jobs in keeping with the village status. (It is reasonable to argue that the perceived status in the village and the size of holding of a household are likely to be strongly correlated). In Khunda both large and small cultivators have well-established family patterns of migration. Scions of the large farmers enter the higher echelons of government service such as the officer corps in the civil service, the army and the police, while the small farmers encourage their offsprings to join the ranks (we noted in Chapter 1 that migration has been an important feature in Khunda for a long time). These patterns facilitate the migration of successive generations to seek employment in keeping with their village status (Haufbauer, 1973,has also argued that the hereditary factor is important in determining employment in Pakistan). Chak, however, is a more recently settled canal colony village. Migrants from this village usually seek jobs in large cities such as Lyallpur and Lahore where the probability of finding low wage jobs requiring few skills may be greater than for well paid skilled jobs. If we argue that households encourage members to take up jobs in keeping with their village status, it follows that those who cultivate large holdings are likely to have a lower probability of finding urban jobs compared to those who cultivate small holdings. As indicated by the sign of the elasticity coefficient, this is true in Khunda as well. However, our argument suggests that the difference in the absolute value of the elasticity coefficients may be explained by the difference in the pattern of migration in the two villages. Thus, it may be easier for large farmers in Khunda to find employment outside the village in keeping with their status compared to the large farmers in Chak.

NFYE is significant in Khunda and Jatli and has the predicted sign (Tables 7.7 and 7.8). The greater sensitivity of NFYE in Khunda may be accounted for by the importance of commuting in determining non-farm income. In Jatli road connections already exist and are used by commuters regularly.

In Khunda commuting is rare and as a special facility, is available only to a few households. A small improvement in access to public transport is likely to increase non-farm incomes through commuting and discourage migration in Khunda by a greater proportion compared to Jatli.

It may be seen from Tables 7.7 and 7.9 that MECE is significant only in Khunda and Chak. From Table 7.10 it can be seen that the value of the elasticity of the probability of migration is lower in Chak compared to Khunda. This is an interesting result and merits some discussion. Binswanger (1977) has argued that an attraction of farm mechanization in South Asia is that the labour time and effort required in preparing land for cultivation is reduced. This contributes in raising the cropping intensity of mechanized farms. Higher cropping intensity may lead to greater employment opportunities. Therefore, rural unemployment caused by mechanization may not be so severe. However, to achieve greater cropping intensity, irrigation may be essential. Thus in Chak (a canal irrigated village) it is more likely than in Khunda (a 'barani' village) that mechanization improves cropping intensity. Due to the compensating effect pointed out by Binswanger, mechanization may lower employment opportunities to a lesser extent in Chak compared to Khunda. Hence the elasticity of the probability of migration with respect to mechanization may be lower in Chak as compared to Khunda. This is confirmed by our estimates of the elasticities in the two villages.

The dummy for sharecropping tenancy in Khunda is significant and has a negative sign. (Table 7.7). Figures in brackets in Table 7.10 indicate that in Khunda,the probability of migration is lower and its elasticity with respect to the significant explanatory variables greater amongst sharecroppers as compared to the other households. An important reason for the lower incidence of migration amongst the sharecropping tenants may be seen in the discussion on sharecropping contracts presented in Section 3.2. of Chapter 3. We argued that sharecropping tenants have specialized skills of husbandry and cultivation that distinguish them from landless labourers. (Also see Bell and Zusman, 1976, on this argument). Having acquired these skills,sharecropping tenants may prefer to look for jobs in rural areas that use their skills before entering the urban job markets. For example, it has been argued that land reform legislation (Herring,1979) and farm mechanization (Alavi, 1971) may result in sharecropping tenants taking up employment as permanent labourers on the farms they previously sharecropped. Landlords may prefer to hire the services of ex-sharecroppers both because of their special skills as cultivators, as well as their knowledge of the land. These factors may explain the lower probability of migration among sharecropping households. Another important explanation may be the tenant's poor access to credit for financing migration. We argued in Chapters 3 and 5 that landowners may facilitate tenant's access to credit for purchasing farm inputs. However, landowners may be unwilling to facilitate borrowing to finance migration.

7.4. Summary and Conclusions

Our main objective in this Chapter was to explain migration decisions in Khunda, Jatli and Chak. Migrants in our villages come from cultivating households, are young males and regularly send back remittances. On the basis of this evidence we made a case for analysing migration decisions in terms of joint household's attempt to maximize its welfare. Thus the unit of observation in our migration function is the household rather than the individual migrant.

We argued that village-end variables are quite important in influencing the decision to migrate. This is particularly true in the course of technological change since the demand for rural credit increases and remittances from migrant members may be important as collateral in the rural credit markets. Also, farm mechanization may result in a surplus of household labour which may be encouraged to seek employment in the urban labour markets. In the empirical migration function that we have estimated, we have included variables that capture the ability to borrow in the rural credit market and expenditure on farm mechanization along with the more 'traditional' variables such as the value of output per capita on the farm, farm acreage per household member, education, non-farm income and tenurial status.

The dependent variable in our migration function is a dummy variable that takes the value 1 when households report migrant members and 0 otherwise. This implies a threshold model of migration. We argued that the ordinary least squares method is inappropriate for estimating such models. We have used probit analysis, involving the maximum likelihood method, for estimating probits which yield probabilities of households having migrant members. Using this procedure we examined our hypotheses regarding the important variables included in the migration function. We find that output per capita, farm acreage and non-farm income are negatively correlated with the decision to migrate while education and farm mechanization are positively correlated. Our results also indicate that the ability to borrow in the rural credit market is positively correlated with migration. Further, we find that sharecropping-tenant households have a lower incidence of rural-urban migration compared to other cultivators.

Using the estimates of the coefficients on explanatory variables in our migration function,we evaluated elasticities of the probability of migration. We discussed the results in terms of inter-village comparisons. This enabled us to comment on some village differences in explaining migration and to indicate the relative merits of public policies that aim to influence the flow of rural-urban migration.

The important conclusions that emerge from our discussion are as follows: The nature of operations in the rural credit market is important in influencing migration. Remittances from migrant members enhance the ability to borrow because lenders may accept remittances as a safe collateral. An implication of this result is that migration may encourage the use of modern inputs on the farm (as argued in Chapter 6). Further, rural-urban migration is likely to be encouraged by farm machanization to a greater extent in areas where there is a limited scope for increasing cropping intensity, compared to areas where cropping intensity can be increased thus creating demand for agricultural labour. Migration is likely to be influenced by the village status of households. However, the important of status depends on the pattern of migration in different villages. Commuting may be important in determining non-farm income which, in turn, influences migration. An increase in commuting facilities is likely to lower migration to a greater extent in villages where households do not commute compared to the villages where commuting patterns are well established.

APPENDIX TO CHAPTER 7

Table 7.11a

Distribution of the annual remittances per household earner in Khunda, Jatli and Chak by the size of holding

(Rupees)

Village \ Size category (1)	Small	Medium	Large	All households
Khunda	562.50	507.50	298.786	1093.58
Jatli	1525.53	1380.24	1000.12	1394.93
Chak	1481.48	979.16	1342.71	1244.49

Table 7.11b

Distribution of the annual remittances per migrant in Khunda, Jatli and Chak by the size of holding

(Rupees)

Village \ Size category	Small	Medium	Large	All households
Khunda	825.00	826.05	6271.42	2096.50
Jatli	2375.87	2605.08	2292.46	2431.78
Chak	3008.33	2474.00	3162.50	2842.46.

Table 7.11c

Distribution of the annual remittances as a proportion of the total value of output on the farm in Khunda, Jatli and Chak by the size of holding

Village \ Size category	Small	Medium	Large	All households
Khunda	1.06	1.22	5.99	2.31
Jatli	4.59	2.25	0.80	3.25
Chak	2.53	0.77	0.55	1.28

(1) For definition of size categories of farms see p in the main text.

Table 7.12

Estimated values of the coefficients of variables explaining migration decisions in Khunda, Jatli and Chak using ordinary least squares method.

Dependent variable [1] ≡ M = 1 if household has a migrant member, 0 otherwise.

(Linear form)

Villages / Explanatory variables [2]	Khunda	Jatli	Chak
TPRODE	-0.0001	0.00011	-0.00003
	(2.72)* [2]	(1.71)*	(1.3)**
HOLDE	-0.13	0.0027	-0.02
	(1.03)	(0.17)	(1.14)
STUDE	-0.02	-0.06	0.004
	(0.36)	(1.34)**	(0.67)
DEBTE	0.0003	-0.000015	0.000001
	(2.10)*	(0.93)	(0.03)
NFYE	-0.000085	-0.000096	-0.00001
	(1.59)**	(2.31)*	(0.20)
MECE	0.000015	0.0000085	0.00001
	(3.02)*	(0.73)	(0.62)
DTEN1	-0.12	-0.06	0.09
	(1.95)*	(0.2)	(0.24)
CONSTANT	0.38	0.52	0.30
R^2	0.23	0.12	0.14
F	2.85*	2.76*	1.73
S.E.	0.31	0.48	0.42
N	194	179	110

1. The regression equation is:

$$M_i = \text{constant} + \beta_1 TPRODE_i + \beta_2 HOLDE_i + \beta_3 STUDE_i + \beta_4 MECE_i +$$

$$\beta_5 DEBTE_i + \beta_6 NFYE_i + \beta_7 DTEN1 + \beta_8 DTEN2 + \upsilon$$

2. For definition of variables see pp. 306, 307 in the main text.
3. Figures in brackets are t - values.

* indicates significance at 5% level while ** indicates significance at 10% level.

CHAPTER 8

CONCLUDING REMARKS

Section 8.1 Conclusions

We have analysed important issues such as the relationship between size of farm and productivity (Chapter 4), tenancy (Chapter 5) technological innovation (Chapter 6) and rural-urban migration (Chapter 7) separately. The main conclusions of our analyses were presented at the end of each chapter. Our discussions suggest that rural factor markets in our villages are far from perfect. For some factors, markets are segmented and allocative decisions vary across cultivators distinguished on the basis of size and tenancy. There are other factors for which markets do not exist at all. We also came across examples of factor markets where quantity rather than price adjustments are made to clear markets. We shall bring together examples of such market imperfections discussed in the previous chapters and then comment on some inter-linkages. We shall also present a brief discussion of the importance of factor market linkages in agricultural production.

In Chapter 4, we argued that an important explanation for the inverse relationship between the size of farm and yield per acre in our villages may be that small farms are usually family farms that use inputs, such as labour, more intensively compared to large farms. This may be explained in terms of the differences in the opportunity cost of family and hired labour. We argued that lower disutility may be attached to working on the family farm compared to working for someone else, so that cultivators are prepared to work harder and longer on family farms. This is one example of a segmented labour market. Another example may be found by bringing together our discussions on tenancy (Chapter 5) and rural-urban migration (Chapter 7). In Chapter 5 we presented evidence indicating that yields on share-cropped lands are often greater than yields on similar land cultivated by owner-cultivators. We offered several explanations for this result. One of the explanations was presented in terms of the working of rural labour markets. We argued that share-croppers have special skills of husbandry that result in increasing their prospects of getting employment in agricultural activities. Thus the opportunity cost of labour on the share-cropped farm may be the expected rural wage. The pattern of rural-urban migration indicates that owner-cultivators migrate frequently to the urban areas so that they may consider the comparatively higher expected urban wage as the opportunity cost for their labour on the farm. Thus landowners may succeed in stipulating greater intensity of labour use on share-cropped land as compared to the owner-cultivated land. This discussion indicates that rural labour markets may be segmented on the basis of differences in the migration patterns and tenurial contracts.

Another example of imperfect factor markets in our villages is the market for managerial skills. In Chapters 4 and 5 we argued that small family farmers and share-croppers have high yields because they have special skills which cannot be marketed easily. We argued that if large landowners could purchase such skills easily, and constant returns to scale operate, they would be as productive as small farmers and there may not be any need for tenancies.

Throughout our discussion we have emphasised the special features of the market for land in our villages. In Chapter 4,we argued that a favourable distribution of the quality of land, measured in terms of soil fertility, may be important in explaining higher yields on the small farms compared to the large farms. In Chapter 2 we commented on some theoretical models that explain the importance of the size of holding in determining cultivators' attitude towards risk while allocating resources on the farm. Evidence on input use in the villages and in Khanewal was analysed in Chapter 6 in the light of these arguments. We concluded that, in general, the size of holding is not proportionately related to the intensity of input use. Our discussion of the market for tenancies presented in Chapters 3 and 5, indicates the special role of the land market in adjusting resource endowments when factor markets function imperfectly. We shall comment on this feature of the land market (a feature that also indicates the nature of factor market linkages), after briefly mentioning two other markets that we have analysed in this study.

In Chapters 4 and 5 we have commented in detail on the absence of markets for bullock services in our villages. We suggested that there may be sociological explanations for this. An important consequence, however, is the existence of tenancies since, in the short run, cultivators adjust excess bullock services by renting in land. We argued that the development of markets for tractor services may remove the constraints imposed by the non-existence of markets for bullock services on the ability of landowners to cultivate their land.

Finally, imperfections in the rural credit markets were discussed in Chapter 3, 6 and 8. We indicated small farmers' difficulties of access to the sources of institutional credit. We argued that attempts to overcome these difficulties also contribute in developing factor market linkages.

There are two examples of factor market linkages that we have discussed in considerable detail in the study. These are, the linkages that explain the incidence of tenancy (Chapter 5) and rural-urban migration Chapter 7). We have stressed their importance in influencing resource allocation and productivity in agriculture.

In Chapter 5, we argued that operations in the land market result in tenancies and are related to the imperfections in the markets for family labour and bullock services. We tested a short run model of tenancy in which agents owning excess land (relative to their endowments of family and bullock labour) rent out land to agents whose endowments of family and bullock labour are in excess relative to the land that they own. The underlying assumptions of the model are based on the observations made earlier regarding imperfections in the bullock and family labour markets, which result in adjustments being made in the tenancy, rather than bullock and labour markets. Our model performs quite well in villages where factor market imperfections prevail and performs poorly in Jatli where the incidence of tractor use and rural-urban migration is high. Operations in the tenancy market are also indicative of linkages between the rural credit and land markets. We argued that share-cropping tenants are as productive as fixed-rent tenants because landowners encourage the use of the new inputs by providing credit to their share-cropping tenants.

In Chapter 7 we examined the factors that influence cultivating households' decision to encourage household members to migrate from rural to urban areas. The nature of operations in the rural credit markets are important in our migration function. We argued that cultivating households' demand for credit to purchase inputs increases during the process of technolgical change. If small farmers have poor access to rural credit, they are likely to encourage members to migrate to urban areas and use the remittances to purchase the new inputs. We also argued that migration may be positively correlated with the availability of credit if lenders in the village consider remittances from migrants a safe collateral. This discussion is indicative of linkages between rural credit and urban labour markets. We argued that such linkages may be important in determining productivity on the farm.

To see the importance of factor market linkages in influencing resource allocation and productivity on the farm let us reconsider the main conclusions of Chapters 4 and 5. These indicate that the existing structure of land tenure (with respect to size and tenancy) is such that small farmers are relatively more productive compared to large farmers, while share-cropping tenants are at least as efficient as other categories of cultivators. These conclusions acquire particular significance if we see them in the context of the debate on 'green revolution' technology. An important argument in the debate is that the tenurial structure of agricultural economies in developing countries may change because small farmers and tenants have poor access to new inputs such as high yield variety seeds, chemical fertilizers and tube-well irrigation. These inputs require cash outlays that are denied to these cultivators due to the poor functioning of rural credit markets. The inverse relationship between farm size and productivity may change because the matrix of inputs is now different,so that small farmers no longer have the traditional comparative advantage over large farmers. It has been argued further that the eviction of tenants is also likely to increase since the landowners may prefer to cultivate land themselves both because they wish to use the new inputs intensively and because of the availability of tractors.

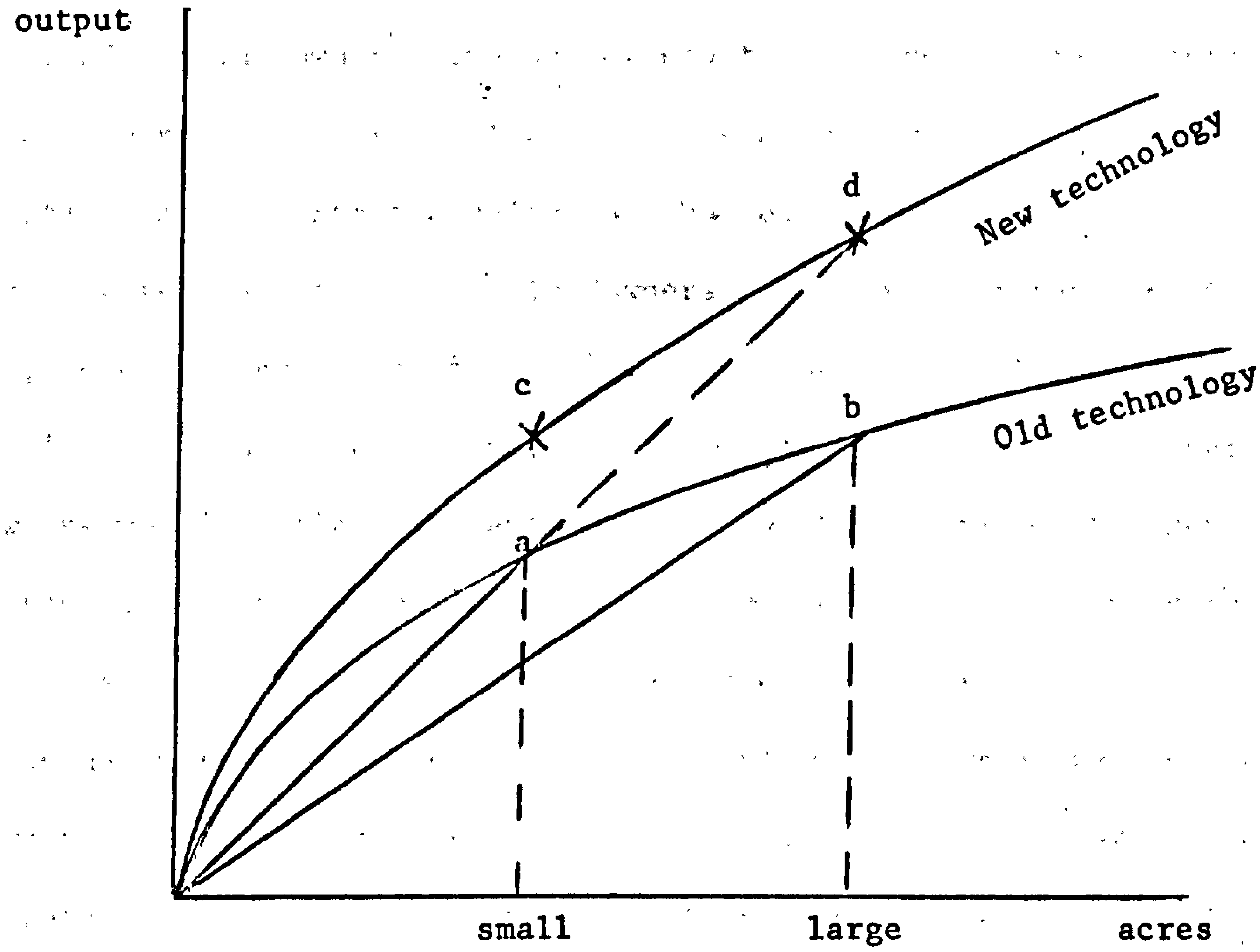
Clearly, there is a need to reconcile our conclusions with these arguments. We may argue that our villages are at an early stage of technological innovation so that the relationship between size of farm and productivity , which is changing over time, may become proportional after the effects of 'green revolution' technology have worked themselves out. Our inter-village comparisons support this argument. Evidence suggests that in the 'barani' villages, where the use of the new inputs is restricted, the inverse relationship is stronger than in the irrigated villages. Thus in the long run, with increased use of new inputs that require greater cash outlays, small farms may indeed be rendered less productive compared to large farms (but see the discussion below). The arguments regarding changes in tenancy are less clear and need to be examined separately.

A more interesting interpretation of our conclusions in the context of the 'green revolution' debate is the following. We examined the evidence on input use on the farm in Chapter 6 and concluded that, in general, there is no significant difference between small and large farmers on the one hand, and different forms of tenurial contracts on the other, regarding the use of biological inputs such as fertilizers and irrigation water. However, large farmers appear to use tractors more intensively compared to other categories of farmers. This evidence casts some doubt on the argument that small owner-cultivators and tenants have a comparative disadvantage regarding the use of new 'green revolution' inputs (tractors may be argued to be a consequence of 'green revolution' technology rather than as an integral part of it). We offered an explanation for these results in terms of the nature of adjustments that are taking place in the rural factor markets to accommodate technological innovation. We presented evidence to suggest that markets for the services of new inputs have developed along with novel distribution mechanisms to facilitate their use by small farmers. Consequently, the inverse relationship may be reasserted in time even with the new technology. 1/

1/. This argument may be seen in terms of shifts and movements along the production function. Consider a production function $F(t, H, \underset{\sim}{x}(H))$ where t is technology, H is land and $\underset{\sim}{x}$ is the vector of co-operating inputs which are a function of the size of holding (see Chapter 4). The production functions for old and new technology are given in Figure 8.1 below. (We hold t and $\underset{\sim}{x}(H)$ constant for each production function.)

1/. (continued)

Figure 8.1



Given the old technology small and large farms lie at points a and b on the production function. As the rays from the origin indicate, output per acre is greater on the small farms compared to the large farms. With the introduction of new technology in the short run only large farms may shift to the higher production function, say to a point such as d . Now a and d lie on the same ray so that output per acre appears to be proportional with size. However, over a longer period of time, with the development of new markets and sources of inputs (as argued in Chapter 6) small farmers also shift to the new production function - in the figure this may be seen in terms of a movement from a to c - and the inverse relationship is re-asserted.

Share-cropping tenants' access to the new inputs is determined by the attitude of landowners towards the new technology. If landowners wish to encourage innovation, they can make adjustments in the tenurial contracts to accommodate technological change. Their activities in rural factor markets other than land (landowners participate in the credit market, see Chapters 3 and 5) are likely to contribute in facilitating tenants' access to the new inputs. The important question is whether landowners would continue to rent out land on share-cropping tenancy given that tractors are available. We may answer this question in the affirmative if we argue that tenants have special husbandry skills, other than owning bullocks for ploughing land, that make them attractive to landowners. Tractors may displace unskilled labour but they are a poor substitute for the skills of tenants. It is likely, therefore, that with appropriate adjustments in contracts, given the nature of production functions and rural wages, landowners may continue to rent out land (they may start renting out tractors) to skilled share-croppers.

Our discussion, aimed at integrating the analysis of the four issues, indicates that two particular categories of factor market linkages may be important in explaining the slow change in the tenurial structure of Pakistani agriculture. The prevalence of the inverse size-productivity relationship may be explained by the inter-action between urban labour and rural credit markets. Further, the continued high incidence of share-cropping tenancy may be explained in terms of the interaction between land, labour and credit markets brought about by the landowners' activities in these markets. This enables the adoption of modern technology using share-croppers' skills. Also, the risk-spreading advantages of sharecropping are retained.

Seen in this light, inter-village differences in the relationship between farm-size and productivity, on the one hand, and tenancy and efficiency on the other, may be interpreted as consequences of village differences in the workings of the rural factor markets.

Section 8.2 Implications for policy

Our discussions of the four issues, analysed in this study enable us to comment on a number of policies initiated in the agricultural sector. In this Section we shall briefly discuss some of these policies.

Land reform policy is much discussed in the literature. The two main objectives of land reforms are to redistribute land to reduce inequalities in land ownership as well as to increase agricultural production and employment. Underlying the second objective of this policy is the belief that small farms use labour more intensively and have higher yields compared to large farms. The evidence from our four ecologically distinct villages supports this belief. However, our analysis suggests that a number of issues need careful examination when implementing land reforms. First, there may be problems in defining land ceilings in acceptable units of measure. We have seen that due to differences in soil fertility, acreage on its own is not a reliable measure. A better measure lies in the concept of produce index units. However, considerable administrative costs may have to be incurred to measure produce index units in different agricultural regions. A related problem refers to the quality of soil surrendered by landowners who own land above the prescribed ceiling. If only land with poor soil fertility is surrendered, the increase in output through land redistribution may be quite small. Another feature that needs to be considered carefully, before estimating the expected increment in agricultural output as a result of land redistribution, is that part of the explanation for higher yields on small farms is that they use mainly family labour that has a lower opportunity cost compared to hired labour. Thus, unless we assume the existence of underemployment on small family farms, land redistribution may result in increased hiring of labour (unless land is given to the landless). This may imply lower intensities of cultivation and lower yields than those anticipated.

It may be argued that land reforms improve small farmers' access to inputs by removing the large farmers who, through their political contacts and influence, corner the markets for new inputs and rural credit. This argument holds if it can be shown that large farmers use inputs wastefully, i.e. they use 'excessive' doses of fertilizer, seed and irrigation. Evidence from our villages does not support this. However, large farmers' easy access to credit may lead to an unsatisfactory allocation of capital if they use credit to purchase tractors instead of the biological inputs, thus lowering the potential for creating employment in the agricultural sector. In this sense, land reforms, by facilitating small farmers' access to credit, may result in greater employment in the agricultural sector.

Finally, land reforms may discourage rural-urban migration through increasing the available food per capita in agriculture and also by creating rural job opportunities for potential migrants.

An important objective of tenancy reform in Pakistan is to increase the share-proportion in output and to lower the share in costs for share-cropping tenants. Another objective is to make it difficult for landowners to evict their tenants. It is well-known that, in practice, tenancy reforms fall far short of their stated objectives. Legislations regarding shares are ignored and evictions are widespread (Herring (1979)). Our analysis of tenancy offers some explanations for this.

The official policy emphasises the populist aspects of tenancy reforms, aimed at redistribution of output rather than efficiency in resource allocation. Landowners, on the other hand, are more likely to be concerned with the latter aspect which determines their own income. Our analysis suggests that when output share is in the same proportion as the share in costs there is likely to be efficiency in resource allocation. Evidence from our villages suggests that many landowners share outputs and costs in this manner. They also supervise plots closely to enforce contracts. On the other hand, there are many landowners who do not supervise land properly, do not pay their share of costs and rely mainly on the threat of eviction to enforce contracts. Here there may be room for increasing yields through policies that increase the incentives for closer supervision and contracting proportional shares in output and costs. But such landowners are likely to be a small proportion of the total number of landowners. We have also seen that efficiency is not an important issue as far as fixed-rent tenancies are concerned.

Regarding the objective of redistribution through tenancy reform our analysis suggests that given corruptions in the administration, policies aimed at improving wages of share-croppers in alternative employment are likely to be more effective at increasing their shares in agricultural produce rather than official fiat. This implies that policies should aim to increase employment opportunities for the landless in rural areas by encouraging labour intensive technologies that increase cropping intensities, thus raising the expected wages in alternative rural employment. Improvements in share-croppers' access to rural credit will also help to strengthen their bargaining power.

It is often argued (see, for example, Bhaduri (1973)), that tenancy discourages the switch to new, more productive technologies and therefore is an undesirbale institution. We have seen that there is little evidence in our villages to support this view. As far as share-cropping tenancies are concerned, legislation that lays down terms of contracts too rigidly and is slow to respond to changes in technology, is likely to discourage the use of new inputs. We have seen that landowners who supervise land closely are likely to have a good knowledge of new opportunities and will adjust contracts to accommodate them (by contracting new cost-sharing arrangements, for example). This also applies to land-improving technology, such as the installation of tube-wells for irrigation.

There is one aspect of tenurial reform that we have not discussed. This is the distributional impact of making tenants owners of the land they cultivate. Clearly, if resources are allocated efficiently on share-cropped farms this is not likely to improve total agricultural output. However, the increment in the tenants' share in the output may be desirable in itself.

In summary, contractual adjustments that take into account the issues of efficiency and adoption of modern technology are best left to the contracting parties. The legislative process is likely to respond more slowly to the new opportunities than the agents involved. Redistribution of output in favour of tenants, however, may be achieved directly by making tenants owners of the plots they cultivate and indirectly by improving the bargaining position of tenants through policies that increase the expected wages in alternative employment.

Our discussion of rural-urban migration suggests that policies that aim to reduce the flow of migrants, because of the associated problems of urban unemployment, are based on a partial analysis of the phenomenon. A more comprehensive approach ought to take into account the welfare implications of remittances sent by migrants to their rural households, thus raising consumption per capita in the household. We have argued that remittances are important in facilitating the switch to new technology by small cultivators both by providing a surplus for investment as well as by lowering risk through diversification of income streams. Thus the policy should take into account these benefits while estimating the net social cost of rural-urban migration. It is more desirable to reduce the flow of migrants to urban areas by policies that tackle the root cause of the problem. Our results indicate that the creation of non-farm employment opportunities and redistribution of land in favour of small farmers is likely to discourage migration. We have also seen that improvements in the operation of rural credit markets that make it easier for the small cultivator to borrow, are likely to lower migration.

Our results indicate that mechanisation encourages migration while share-cropping tenancy discourages it. To the extent that mechanisation may displace tenants, rural-urban migration is likely to increase even further. This suggests the need to revise policies that subsidise the purchase of farm machinery. We have argued that an important net benefit of migration may be the increase in the cropping intensity through the use of new inputs. However, there are alternative ways of increasing cropping intensity. Some of these involve the provision of incentives to use tube-wells for extending irrigation and research in new strains of crops that require a shorter maturing period. These are labour intensive strategies that are likely to increase employment opportunities on owner-cultivator farms and also to discourage the eviction of tenants, with a consequent reduction in rural-urban migration.

In many discussions of agriculture in developing economies, land reforms are considered to be particularly important in improving resource allocation and productivity (see Bhaduri (1973), Griffin (1974), Myrdal (1968). Our discussion in this section indicates that often land reforms are expected to do more than what is realistically possible. One explanation for this is that land reforms use country-wide criteria while determining legislations on land ceilings and terms of tenancy contracts. Our analysis indicates that given the nature of agricultural activities, variations in market imperfections and market linkages, these criteria may be inoperable in practice. For example, we have argued that landowners provide land as well as credit to share-croppers because rural credit markets are imperfect. Tenancy reforms, that give ownership rights to tenants without at the same time improving their access to the credit market may not achieve the objective of increasing agricultural productivity.

A related difficulty with land reforms arises on account of the lack of political will to implement them. In Pakistan there exists an elaborate bureaucratic structure that could be used to interpret the broad criteria of land reforms in the context of specific regional environment. However, in the absence of penalities, there is little incentive to attempt serious implementation. An interesting discussion of the issues involved here may be seen in Myrdal (1968) where it is argued that there is a gap between political rhetoric and effective action in the 'soft' state structure of developing countries.

Section 8.3 Some suggestions for further research

Our villages provide case studies illustrating the importance of the four issues(and their inter-linkages)that have been the focus of our discussion. For policy purposes, however, it is important to examine, at the country-wide level, the results that we have suggested. This requires a more comprehensive data base than the one we have analysed. There is a need, therefore, to initiate village studies where the sampleof villages is chosen to represent the farming households in each major ecological zone in the country. It is important to identify such zones carefully since decisions regarding resource allocation on the farm are influenced by the cropping pattern which, in turn, is determined by climatic conditions, soil fertility and the availability of irrigation.

The process of data collection itself is vital in determining the quality of evidence that is needed. The questionnaire method is useful only if the information it provides is a close approximation to reality. It is important, therefore, for the interviewer to establish a rapport with the farmers. This takes time. Thus, the quality of the evidence is determined to an important extent by the length of time spent by the interviewer in each village. To avoid biases due to the initial 'teething troubles' and climactic variations, it is desirable to interview each household in the sample over at least two annual cropping seasons.

In our discussion of the size-productivity relationship we offered a number of explanations for our results. These were based on our discussions of the influence of the quality of soil, access to irrigation, the proportion of family to hired labour etc. in determining the relationship. The evidence that we provided in these discussions was indirect. We referred to the broad impressions formed by the research team during visits to the villages (and to sources other than our village studies). A better approach is to collect direct evidence at the household level in each village. A comprehensive study of villages of the type discussed above would pay particular attention to this aspect.

Our discussion of tenancy suggested several important areas where empirical and theoretical research may be extended. In our discussion, we took the rental share to be fixed at half of the farm produce. This, by and large, is supported by the evidence collected in our interviews with the tenants. However, throughout our discussion we referred to instances where changes are taking place in the rental share as a result of mechanisation. In Khanewal we were told, in informal discussions, that a growing trend in the area was that landowners rent out both tractors as well as land to potential tenants and at the same time lower tenants' share in the produce. Also, the tenant is not required to provide bullock services on the farm. The discussion of this adjustment in the tenancy contract requires careful examination of the evidence. It would be interesting, for example, to estimate the value of the share and compare it with the wages of the permanently hired labourers. The difference, if it exists, may respresent the implicit price of the husbandry skills of the tenants. It is important also to determine how widespread is the incidence of such contractual adjustments and whether it is limited to regions with a specific cropping pattern.

The extent and the nature of changes taking place in the share-proportion may indicate the need to extend the theoretical models that explain the determination of the rental share. Two well-known theoretical models are;the competitive model of Bardhan and Srinivasan (1971) and the game theoretic model of Bell and Zusman (1976). These models may be extended to determine the impact of bullock-displacing technological innovation. In the latter model it would be particularly interesting to discuss the impact of this on the relative bargaining power of tenants and landowners, and hence on the equilibrium rental share.

While conducting our field survey in Khanewal we noted a form of rental contract that has received little attention in theoretical discussions on tenancy. We observed that a plot of land was rented on different contracts concurrently. Under this arrangement, the landowner rents out land to a fixed-rent tenant who, in turn, rents it out to a share-cropper. This appears to be an example of special services being provided by a middleman - in this case a fixed- rent tenant - to bring together the landowner and the cultivator. One possible approach in discussing sub-leasing contracts may be to analyse the relative levels of risk aversion of the three agents involved. This requires a careful description of the agents to identify the ownership pattern of assets that may influence risk aversion. Casual observation in Khanewal suggests that landowners involved in sub-leasing contracts are usually medium sized owning up to 50 acres and, typically, are absentee landowners. Fixed-rent tenants are usually middlemen with strong connections in rural credit and grain markets. Finally, share-croppers involved in this contract are often landless cultivators. However, more reliable and carefully collected data is needed before the three agents can be thus classified and theoretical extensions attempted.

Our discussion of technology in this study has been restricted to certain aspects that are of direct relevance to the broad arguments that inter-link our analyses and were presented in Section 8.1. Data collected in Khanewal allow us to go considerably further than this discussion. In our interviews we asked detailed questions about varieties of seeds and fertilizers used on the farm. We also collected data on the number of years that each variety of seed and fertilizer , tractor and tube-well had been in use for each farmer in the sample. This allows us to examine an aspect of 'green revolution' technology that has received little attention so far. This concerns the impact of learning on productivity. Thus we may test hypotheses that postulate a relationship between learning by doing (Arrow (1962) and may suggest explanations for the recent evidence indicating a decline in the use of 'green revolution' technology inputs. Detailed data are also available on mandays of employment of family and hired labour on the farm for each major crop. This will enable us to test hypotheses regarding imperfections in the labour markets in the framework of well-specified production functions. We propose to use the data from Khanewal in carrying out research along these lines at a later stage.

In the study of migration in our three villages we emphasised the importance of rural-end variables in influencing rural-urban migration by cultivating households. We then proceeded to estimate a migration model containing such variables. It is quite likely that our migration functions are misspecified because information on important urban-end variables,such as the urban wage rate, urban contracts and distances to urban labour markets,are missing in the set of data collected by the research team in Islamabad. In the ideal survey that we described earlier, information concerning urban-end variables could easily be collected. Direct evidence could also be obtained on the operations in the rural credit market to determine whether remittances are a desirable collateral for the creditors. The ideal survey may be designed to test comprehensively Stark's arguments regarding the relationship between technological change and migration. We argued earlier that data should be collected for two crop years. This will allow us to identify the households which start receiving remittances after some time has elapsed (for job search, etc.,) since making the decision to encourage household members to migrate. This valuable information will give a better idea of the success rate of finding urban jobs and the saving pattern of the successful job hunters. Data may also be collected to enable an analysis of the allocation of remittances by the households at the village end. This will allow a detailed examination of Stark's model and our arguments concerning operations in the rural credit markets. Evidence is also needed to examine the pattern of migration of all the village households to analyse changes in the tenurial structure of rural Pakistan.

The analysis of the issues presented in this study have helped us to understand some important aspects of agricultural production in Pakistan. We hope to extend our research along the lines described in this Section, in order to understand these issues better and examine them at the country-wide level.

BIBLIOGRAPHY

Ahmed, N. (1980) "The Determinants of Tenants' Bargaining Power in a Pakistani Village", mimeograph, Quaid-e-Azam University, Islamabad.

Ahmed, S. (1977) Class and Power in a Punjabi Village, Monthly Review Press, London.

Akram, M. (1962) "Socio-economic Effects of Industrialization of Lyallpur Town on the Surrounding Rural Areas", unpublished M.Sc. thesis, Department of Agricultural Economics, West Pakistan Agricultural University, Lyallpur.

Alavi, H. (1974) "Rural Bases of Political Power in South Asia", Journal of Contemporary Asia, Vol. IV, No.4.

Alavi, H. (1972) "Kinship in West Punjab Villages", Contributions to Indian Sociology, New Series, No.VI.

Alavi, H. (1971) "The Politics of Dependence : A Village in West Punjab", South Asian Review, Vol.4, No.2.

Ali, M., Butcher, W.R. and Gotsch, C.H. (1973) Temporary Migration of Workers and Return Flows of Remittances in Pakistan, Harvard University, Development Research Group, Economic Development Report No.234.

Ali, M. (1973) "Frontier Migration to Industrial Areas of West Pakistan : A Case of Temporary Migration with Return Flow of Funds", unpublished Ph.D dissertation, Washington State University. Pullman.

Arrow, K.J. (1962) "The Economic Implications of Learning by Doing", Review of Economic Studies (June).

Arrow, K.J. (1971) "The Theory of Risk Aversion", in Essays in the Theory of Risk Bearing, by K.J. Arrow, Markham Publishing Company, Chicago.

Aslam, M.M. (1978) "Some Comparative Aspects of Production and Profit Functions : Empirical Applications to a Punjab District", Pakistan Development Review, Vol.XVII, No.2 (Summer).

Atkinson, A.B. (1970) "On the Measurement of Inequality", Journal of Economic Theory, Vol.2.

Bardhan, P.K. and Srinivasan, T.N. (1971) "Cropsharing Tenancy in Agriculture : A Theoretical and Empirical Analysis", American Economic Review, Vol.61.

Bardhan, P.K. (1973) "Size, Productivity and Returns to Scale : An Analysis of Farm Level Data in Indian Agriculture", Journal of Political Economy, Vol.81.

Barth, F. (1959) Political Leadership Among Swat Pathans, Athelon Press London.

Bell, C.J. and Zusman, P.(1976) "A Bargaining Theoretic Approach to Cropsharing Contracts", American Economic Review, No.4.

Bell, C.J. (1977) "Alternative Theories of Sharecropping : Some Tests Using Evidence from North East India", Journal of Development Studies, 13, 4, (July).

Berry, A.S. and Soligo, R. (1968) "Rural-urban Migration, Agricultural Output and the Supply Price of Labour in a Labour Surplus Economy", Oxford Economic Papers, Vol.20.

Bhaduri, A. (1973) "Agricultural Backwardness under Semi-feudalism", Economic Journal, Vol.83.

Bhagwati, J.N. and Chakravarty, S. (1969) "Contributions to Indian Economic Analysis", American Economic Review, supplement, Vol.59.

Bhagwati, J. and Srinivasan T.N. (1973) On Re-analysing the Harris-Todaro Model : Policy Rankings in the Case of Sector-Specific Sticky Wages, Working Paper No.99, Cambridge M.I.T.

Bharadwaj, K. (1974), Production Conditions in Indian Agriculture, Cambridge University Press, London.

Bhattacharya, N. and Saini, G.R. (1972) "Farm Size and Productivity : A Fresh Look", Economic and Political Weekly, Vol.7, No.24, (June).

Binswanger, H.P. (1977) The Economics of Tractors in the Indian Subcontinent I.C.R.I.S.A.T., Hyderbad, India.

Blalock, H.G. (1972) Social Statistics, 2nd edn., McGraw-Hill, New York.

Bliss, C.J. and Stern, N.H. (1978) "Productivity, Wages and Nutrition Part I : The Theory and Part II : Some Observations", Journal of Development Economics, pp.331-398.

Bliss, C.J. and Stern, N.H. (1980) Palanpur : Studies in the Economy of a North Indian Village, Oxford University Press (forthcoming).

Bose, S.R. and Clark, E.H. (1969) "Some Basic Considerations on Agricultural Mechanization in West Pakistan", The Pakistan Development Review, Vol.1, No.3 (Autumn), pp.273-308.

Bowles, S. (1970) "Migration as Investment : Empirical Tests of the Investment Approach to Geographical Mobility"; Review of Economic Studies, Vol.52.

Barnum, H.N. and Sabot, R.H. (1975), "Education, Employment Probability and Rural-urban Migration in Tanzania", paper presented at the 1975 World Congress of the Econometric Society, (mimeograph), Toronto.

Byers, T.J. (1972) "The Dialectics of India's Green Revolution", South Asian Review, (January).

Cheung, S.N.S. (1968) "Private Property Rights and Sharecropping", Journal of Political Economy, Vol.76.

Cheung, S.N.S. (1969) "Transaction Costs, Risk Aversion, and the Choice of Contractual Arrangements", The Journal of Law and Economics, Vol.XII (1), (April).

Cheung, S.N.S. (1969a) The Theory of Share Tenancy, University of Chicago Press.

Chow, G.C. (1960) "Tests of Equality between Subsets of Coefficients in Two Linear Regressions", Econometrica, pp.591-605.

Connell, J., Dasgupta, B., Ray, L. and Lipton, M. (1974) Migration from Rural Areas, the Evidence from Village Studies, I.D.S. at the University of Sussex, Discussion Paper No.39.

Dantwala, M.L. (1966) "Institutional Credit in Subsistence Agriculture", International Journal of Agricultural Affairs, Vol.5, No.1,(December)

Darling, M.L. (1928) Punjab Peasant in Prosperity and Debt, London.

Darling, M.L. (1934) Wisdom and Waste in the Punjab, London.

Dixit, A.K. (1968) "Optimal Development in the Labour Surplus Economy", Review of Economic Studies, Vol.35.

Eckert, J.B. (1972) Rural Labour in Punjab, (mimeograph) Planning and Development Department, Government of Punjab, Lahore.

Ercelawn, A.A. (1980) Rural Poverty, Agricultural Productivity and Adoption of Technology, E.S.C.A.P./Q.U.A. Project on Social Participation in Rural Development, Department of Economics, Quaid-e-Azam University, Islamabad.

Falcon, W.P. (1970) "The Green Revolution : Generation of Problems", American Journal of Agricultural Economics, Vol.52.

Falcon, W.P., and Gotsch, C. (1967) Agricultural Development in Pakistan, Center for International Affairs, Cambridge, Mass.

Farrell, M.J. (1957) "The Measurement of Production Efficiency", Journal of the Royal Statistical Society.

Fei, J.C.H. and Ranis, G. (1964) Development of the Labour Surplus Economy: Theory and Policy, Irwin, Homewood, Ill.

Field, G. (1975) "Rural-urban Migration, Urban Unemployment and Under-Employment and Job-search Activity in the L.D.C's, Journal of Development Economics, (June).

Finney, D.J. (1971) Probit Analysis, 3rd edn., Cambridge University Press, Cambridge, Mass.

Fisher, R.A. and Yates, F. (1964) Statistical Tables for Biological, Agricultural and Medical Research, 6th edn., Oliver and Boyd, Edinburgh.

Goldberger, A.S. (1964) Econometric Theory, Wiley, New York.

Goldfeld , S.M. and Quandt, R.E. (1972) Non-linear Methods in Econometrics, North Holland, Amsterdam.

Gough, K. and Sharma, H. (1975) eds. Imperialism and Revolution in South Asia, London Monthly Review Press.

Government of India, Ministry of Food and Agriculture, Studies in the Economics of Farm Management for Bombay, Madhya Pradesh, Madras, Punjab, Uttar Pradesh and West Bengal, 1954-55, 1955-56 and 1956-57.

Gronau, R. (1973) "The Effect of Children on the Housewife's Value of Time", Journal of Political Economy, Vol.81, Part II.

Greenwood, M. (1969) "The Determinants of Labour Migration in Egypt", Journal of Regional Science, (August).

Greenwood, M. (1971) "An Analysis of the Determinants of Internal Labour Mobility in India", Annals of Regional Science, (August).

Griffin, K. (1974) The Political Economy of Agrarian Change, MacMillan, London.

H ufbauer, G.C. (1973) "Occupational Trends and Social Mobility in the West Punjab", Pakistan Economic and Social Review, (Spring).

Harris, J. and Todaro, M.P. (1970) "Migration, Unemployment and Development: a Two-Sector Analysis ", American Economic Review, (March).

Hay, M.J. (1974) An Economic Analysis of Rural-urban Migration in Tunisia, (unpublished Ph.D. thesis), University of Minnesota.

Heady, O. and Dillon, J.L. (1961) Agricultural Production Functions, Ammes: Iowa University Press.

Helbock, R.W. (1975) "Differential Urban Growth and Domestic Migration Flows in Pakistan", Pakistan Development Review, Vol.XIV, No.1, (Spring).

Helbock, R.W. (1975) "Urban Population Growth in Pakistan 1961-1972", Pakistan Development Review, Vol.XIV, No.3, (Autumn).

Herring, R. (1979) The Rationality of Tenant Quiescence in Tenure Reform: Production Relations and the Liberal State, (mimeograph) North Western University.

Hill, L. and Kau, P. (1973) "Applications of Multivariate Probit to a Threshold Model of Grain Dryer Purchasing Decisions", American Journal of Agricultural Economics, Vol.55, No.1.

Hirschman, A.O. (1958) The Strategy of Economic Development, Yale University Press, New Haven.

Hopper, D.W. (1965) "Allocation Efficiency in Traditional Indian Agriculture", American Journal of Farm Economics, Vol.47.

Johnson, D.G. (1950) "Resource Allocation under Share Contracts", Journal of Political Economy, Vol.58, pp.111-123.

Johnson, G.E. (1971) "The Structure of Rural-Urban Migration Models", East African Economic Review, (June).

Jorgenson, D.W. (1961) "The Development of A Dual Economy", Oxford Economic Papers, Vol.19.

Johnston, J. (1972) Econometric Methods, 2nd. edn., McGraw-Hill, Tokyo.

Jorgenson, D.W. (1967) "Surplus Agricultural Labour and the Develoment of a Dual Economy", Oxford Economic Papers, Vol.19.

Junankar, P.N. (1976) "Land Tenure and Indian Agricultural Productivity", Journal of Development Studies, Vol.13, (Nov), pp.42-60.

Junankar, P.N. (1977) Tests of the Profit Maximization Hypothesis : A Study of Indian Agriculture, Discussion Paper No.96, Department of Economics, University of Essex.

Khan, M.H. (1975) The Economics of Green Revolution in Pakistan, Praeger, New York.

Khan, M.H. (1979 "Farm Size and Land Productivity Relationships in Pakistan", Pakistan Development Review, Vol.XVIII, No.1, (Spring).

Khusro, A.M. (1964) "Returns to Scale in Indian Agriculture", Indian Journal of Agricultural Economics, Vol.19.

Khusro, A.M. (1974) The Economics of Land Reform and Farm Size in India, Institute of Economic Growth, MacMillan, India.

Kmenta, J. (1971) Elements of Econometrics, MacMillan, New York.

Lau, L.J. and Yotopoulos, P.A. (1971) "A Test for Relative Efficiency and Application to Indian Agriculture", American Economic Review, (March) pp.94-109.

Leibenstein, H. (1966) "Allocative Efficiency vs X-Efficiency", American Economic Review, (June) pp.392-415.

Levy, M. and Wadycki, . (1972) "A Comparison of Young and Middle-aged Migration in Venezuela", Annals of Regional Science, No.2.

Lewis, W.A. (1954) "Economic Development with Unlimited Supplies of Labour", Manchester School, Vol.22.

Lipton, M. (1976) "Migration from Rural Areas of Poor Countries : the Impact on Rural Productivity and Income Distribution", paper presented at the World Bank Research Workshop on Rural-Urban Labour Market Interactions, Washington D.C.

Lowdermilk, M.K. (1972) Diffusion of Dwarf Wheat Production Technology in Pakistan's Punjab, (unpublished Ph.D. thesis) Cornell University.

Marschak, I. and Andrews,W.H. (1944) "Random Simultaneous Equations and the Theory of Production", Econometrica, (July) pp.143-205.

Marshall, A. (1966) Principles of Economics, 8th edn., MacMillan, London.

Mazumdar, D. (1963) "On the Economics of Relative Efficiency of Small Farmers", The Economic Weekly, Special Number, Vol.15.

Mazumdar, D. (1965) "Size of Farm and Productivity: A Problem of Indian Peasant Agriculture", Econometrica, Vol.32.

Mohammed, G. (1965) "Private Tubewell Development and Cropping Patterns in West Pakistan", Pakistan Development Review, Vol17 (Summer).

Myrdal, G. (1968) Asian Drama, Pantheon, New York.

McFadden, D.E.L.(1970) Cost, Revenue and Profit Functions, (mimeograph) Berkeley, University of California.

McInerney, J.P. and Donaldson, G.F. (1975) The Consequence of Farm Tractors in Pakistan, World Bank Staff Working Paper No.210.

Naseem, S.M. (1979) "Rural Poverty As a Constraint on Rural Development in Pakistan", paper presented to the 16th World Conference of the Society for International Development, Colombo.

Nadiri, M.I. (1970) "Some Approaches to the Theory and Measurement of Total Factor Productivity : A Survey", Journal of Economics Literature, (December).

Nowshirwani, V.F. (1967) "Allocation Efficiency in a Traditional Indian Agriculture : Comment", American Journal of Farm Economics.

Nerlove, M. (1965) Estimation and Identification of Cobb-Douglas Production Functions, Amsterdam : North-Holland.

Newbery, D.M.G. (1973a) "The Choice of Rental Contract in Peasant Agriculture", in L. Reynold (ed.) Agriculture in Development Theory, Yale University Press, New Haven.

Newbery, D.M.G. (1975) "Tenurial Obstacles to Innovation", Journal of Development Studies, (July).

Newbery, D.M.G. (1976) "Risk Sharing, Sharecropping and Uncertain Labour Markets", Stanford University, I.M.S.S. Economics Series Report No.202.

Nugent, J.B. and Yotopoulos, P.A. (1976) Economics of Development, Harper & Row, New York.

Nulty, L. (1972) The Green Revolution in West Pakistan : Implications of Technological Change, Draeger, New York.

Nurkse, R. (1953) Problems of Capital Formation in Underdeveloped Countries, Blackwell, Oxford.

Pakistan, Ministry of Agriculture & Works (1968) Farm Management Research in Pakistan : Report on Muzaffargarh for 1962-63, Rawelpinidi.

Pakistan, Ministry of Agriculture & Works (1968) Farm Management Research in Pakistan : Report on Hazara Project for 1963-64/1965-66.

Pakistan, Ministry of Food, Agriculture & Underdeveloped Areas (1972) Farm Management Research in Pakistan : Report on Gujranwala Project, Islamabad.

Pakistan, Agricultural Census organisation, Census of Agriculture 1972 : Province Report : Punjab, Vol.2, Part III, Lahore.

Pakistan, Agricultural Census organisation, Census of Agriculture 1972 : All Pakistan, Vol. 1, Lahore.

Pakistan, Agricultural Census organisation, Census of Agriculture 1972, Special Report : Selected Data by Subdivisions, Vol.5, Lahore.

Pakistan, Agricultural Census organisation, Census of Agricultural Machinery 1975 : Final Report, Lahore.

Patnaik, U. (1972) "Economics of Farm Size and Farm Scale", Economics and Political Weekly, special number, Vol.7.

Punjab Government (1884) Gazeteer of the Moultan District, 1883-84, Arya Press of Randas, Lahore.

Quaid-e-Azam-University, (1978) Methodology of Survey for the Study of Poverty in Pakistan, E.S.C.A.P. Project, (mimeograph).

Rao, C.H.H. (1963) "Farm Size and Economies of Scale", Economic Weekly, Vol.15.

Rao, C.H.H. (1966) "Alternative Explanations of the Relationship between Farm Size and Output per Acre in India", Indian Economic Review, Vol.1.

Rao, A.P. (1967) "Size of Holding and Productivity", Economic and Political Weekly, Vol.2, No.11, (November).

Rudra, A. (1968) "Farm Size and Yield per Acre", Economic and Political Weekly, Vol.3.

Reid, J.D. (1974) Sharecropping in History and Theory, University of Pennsylvania.

Reynolds, L.G. (1969) "Relative Earnings and Manpower Allocation in Developing Economies", Pakistan Development Review, Vol.9, No.1, (Spring).

Rodinson, M. (1977) Islam and Capitalism, Penguin.

Rudra, A. (1968a) "More on Returns to Scale in Indian Agriculture", Economic and Political Weekly, Vol.3.

Saini, G.R. (1971) "Holding Size, Productivity and Some Related Aspects of Indian Agriculture", Economic and Political Weekly, Vol.6, No.26, (June).

Salam, A. (1976) "Resource Productivity and Punjab's Agriculture", Pakistan Development Review, Vol.XV, No.1 (Summer).

Salam, A. (1978) "Factor Input Use and Farm Productivity on Different Farm Categories in the Punjab", Pakistan Development Review, Vol.XVII, No.3, (Autumn).

Seitz, W.D. (1970) "The Measurement of Efficiency Relative to a Frontier Production Function", American Journal of Farm Economics, (November).

Sanghvi, P. (1969) Surplus Manpower in Agriculture and Economic Development Asia Publishing House, Bombay.

Schultz, T. (1964) Transforming Traditional Agriculture, Yale University Press, New Haven.

Searle, S.R. (1971) Linear Models, Wiley, New York.

Sen, A.K. (1962) "An Aspect of Indian Agriculture", Economic Weekly, Annual Number, Vol.16.

Sen, A.K. (1964) "Size of Holding and Productivity", Economic Weekly, Annual Number, Vol.16.

Sen, A.K. (1966) "Peasants and Dualism With or Without Surplus Labour", Journal of Political Economy, Vol.74.

Sen, A.K. (1973) On Economics of Inequality, Oxford University Press.

Sen, A.K. (1975) Employment, Technology and Development, Clarendon Press Oxford.

Sidhu, S.S. (1974) "Economics of Technical Change in Wheat Production in Indian Punjab", American Journal of Agricultural Economics, 56, pp.127-226.

Sidhu, S.S. (1974) "Relative Efficiency in Wheat Production in the Indian Punjab", American Economic Review, (September).

Sjaastad, L.A. (1962) "The Cost and Return of Human Migration", Journal of Political Economy, Supplement, Vol.70, No.1.

Spate, O.H.K. and Learmoth, A.T.A. (1972) India and Pakistan, Methuen, London.

Srinivasan, T.N. (1973) "Farm Size and Productivity : Implications of Choice under Uncertainty", Sankhya, Vol.34.

Stern, N.H. (1972) "Optimum Development in a Dual Economy", Review of Economic Studies, Vol.39.

Stern, N.H. (1977) On Labour Markets in Less Developed Countries, Mimeo, St. Catherine's College, Oxford.

Stark, O. (1975) Utility, Technological Change, Surplus and Risk : The Micro-Economics of Rural to Urban Migration of Labour in Less Developed Economies, (unpublished Ph.D. thesis), University of Sussex.

Stiglitz, J.E. (1974) "Incentives and Risk Sharing in Sharecropping", The Review of Economic Studies, Vol.2, No.126, (April), pp.219-256.

Stiglitz, J.E. (1976) "The Efficiency Wage Hypothesis, Surplus Labour and the Distribution of Incomes in LDC's", Oxford Economic Papers.

Sturt, D.W. (1965) "Producer Response to Technological Change in West Pakistan", Journal of Farm Economics, No.47, (August).

Theil, H. (1971) Principles of Econometrics, Wiley, New York.

Turnham, D. (1971) The Employment Problems of Less Developed Countries, O.E.C.D.

Waters, A.R. (1973) "Migration, Remittances and the Cash Constraints in African Small Holder Economic Development", Oxford Economic Papers, (New Series), Vol.25, No.3,(November).

Walters, A.A. (1963) "Production and Cost Functions: An Econometric Survey", Econometrica, (January) pp.1-66.

Wallis, K.F. (1973) Topics in Applied Econometrics, Gray-Mills, London.

Zellner, A., Kmenta, J. and Dreze, J. (1966) "Specification and Estimation of Cobb-Douglas Production Function Models", Econometrica.